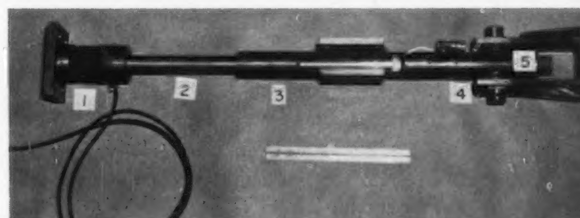
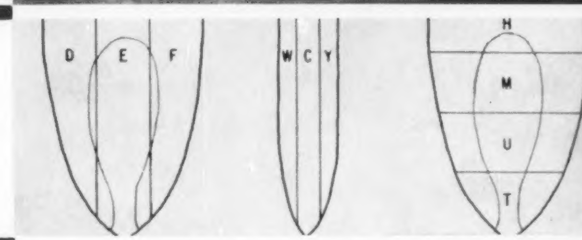
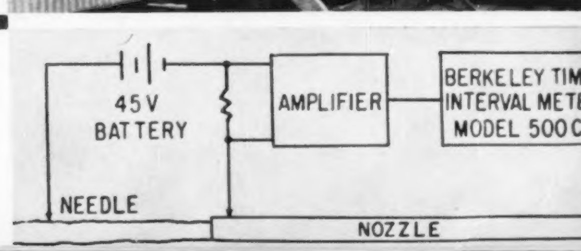
APRIL 1961

Agricultural Engineering

The Journal of the American Society of Agricultural Engineers







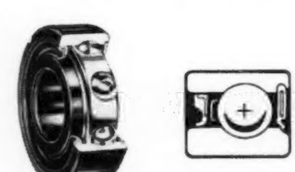
NEW DEPARTURE CASE HISTORY

HOW N/D BALL BEARINGS REDUCE MOWER MAINTENANCE AND PRODUCTION COSTS!

PROBLEM: Manufacturer of well-known power lawn mower wanted to make unit more maintenance-free.

SOLUTION: Complete re-evaluation of all rotating parts including a study of rotary blade bearings by N/D Sales Engineer. His recommendation: Replace six existing non-integrally sealed bearings with lubricated-for-life New Departure ball bearings. These factory greased bearings are equipped with integral Sentri-Seals* and Land-Riding Seals. Results: Greater consumer sales appeal by doing away with the need for relubrication maintenance. In addition, N/D's compact ball bearings reduce production cost by eliminating separate bearing seals and six unnecessary grease fittings.

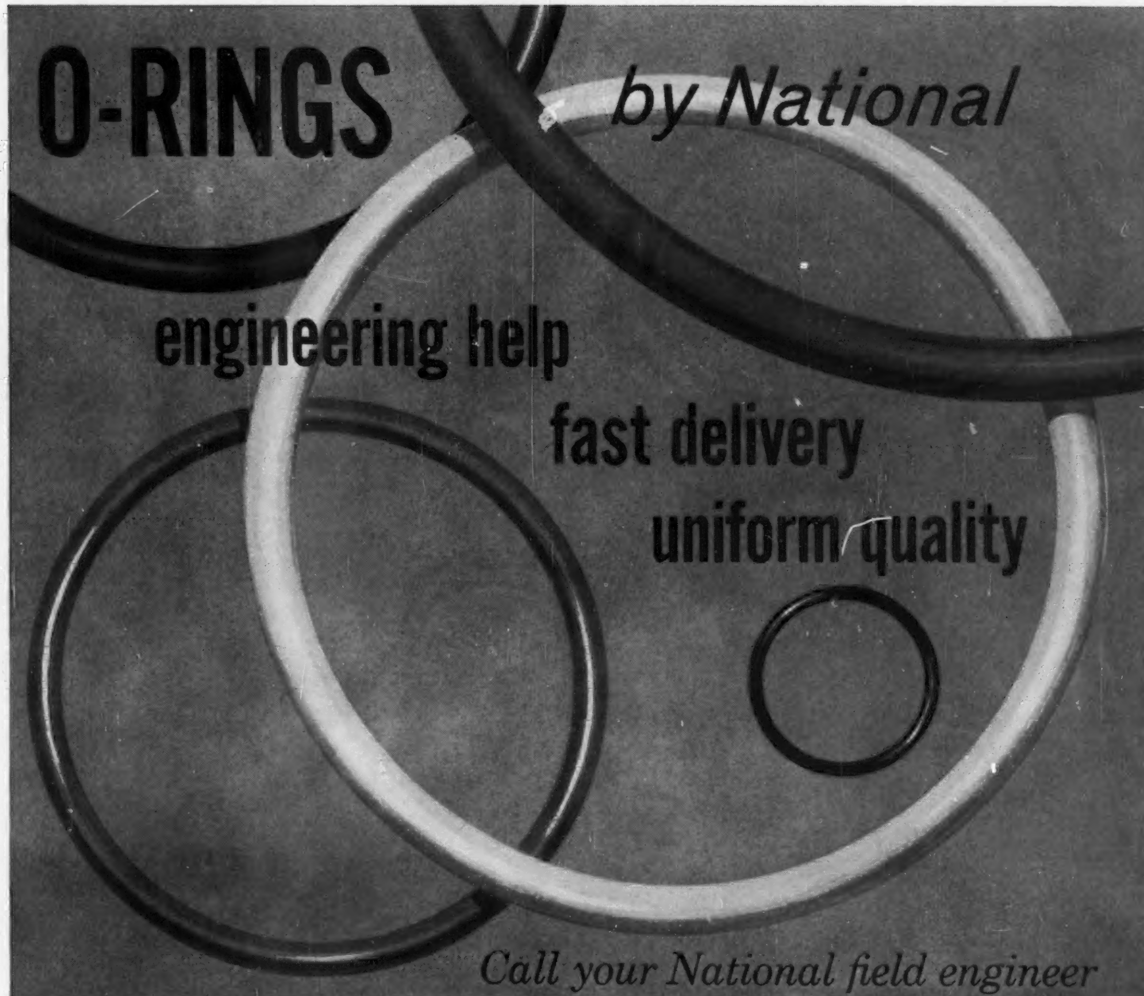
If you're designing new products involving bearings, invite a N/D Sales Engineer to your next design discussion. His knowledge of bearing engineering may result in a savings and valuable new product sales features. Contact him at your local N/D Sales Engineering Office, or call or write New Departure, Division of General Motors Corporation, Bristol, Connecticut. *New Departure Registered Trade Name.



Integrally sealed N/D ball bearings eliminate need for relubrication, grease fittings and separate seals. These heavy-duty N/D bearings with Sentri-Seals* and Land-Riding Seals, shut out moist or dry contaminants.

NEW DEPARTURE

BALL BEARINGS · PROVED RELIABILITY YOU CAN BUILD AROUND



National O-Rings are precision made, uniform industrial rings available throughout the United States—promptly! Quality is superior; all ingredients are inspected before compounding and compounding is strictly controlled for maximum uniformity. Molding is done on modern equipment by veterans of 20 years in O-Ring manufacture. Every precaution is taken to insure that no O-Rings with cuts, scratches or mold defects are shipped.

NATIONAL SEAL
Division, Federal-Mogul-Bower Bearings, Inc.
General Offices: Redwood City, California
Plants: Van Wert, Ohio, Redwood City and Downey, California

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George W. Smith Company
3130 Maple Dr., N.E.
JAckson 233-7383

Chicago (Franklin Park) Illinois
10013 West Grand Ave.
GLadstone 5-4420

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210 Heights Rockefeller Bldg.
3091 Mayfield Road at Lee
YEllowstone 2-2720

Dallas 19, Texas
Benson Engineering Company
2514 West Mockingbird Lane
FLeetwood 2-7541

Detroit 27, Michigan
13836 Puritan Avenue
VErmont 6-1909

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2802 N. Delaware St.
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Agricultural Engineering

Established 1920

CONTENTS • **APRIL, 1961** • **Vol. 42, No. 4**

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JAMES BASSELMAN, *Editor and Publisher*

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Introducing "Check Points"

BEGINNING with this issue and to run regularly, or as availability of pertinent information dictates, is a new column entitled "Checks Points" written by J. L. Butt, executive secretary of ASAE. The new column developed from a desire to keep the membership better informed on timely activities about the Society, its headquarters, and the work of its membership. Such information has been received most favorably when presented orally at various Section meetings. The new column will extend distribution of this type of Society information to those who are not in attendance at the meetings when reports of this type are given by Society officers.

The title "Check Points" was selected because the column is intended to be just that: "Check points" for each member to keep informed of the most timely Society functions, to get background information on new developments, and to be more familiar with the work of the organization. As each subject is discussed, Jimmy's analysis of its importance and effect on ASAE growth and development should help to maintain a common understanding among ASAE members of the Society's course of action.

Since check points are points from which actions can be compared or analyzed to establish direction or course, they are also points from which unhealthy situations can be stopped. We sincerely feel that the new column can serve a most valuable service to ASAE and its members. Good luck, Jimmy, in your new venture.

The new column appears on page 198.

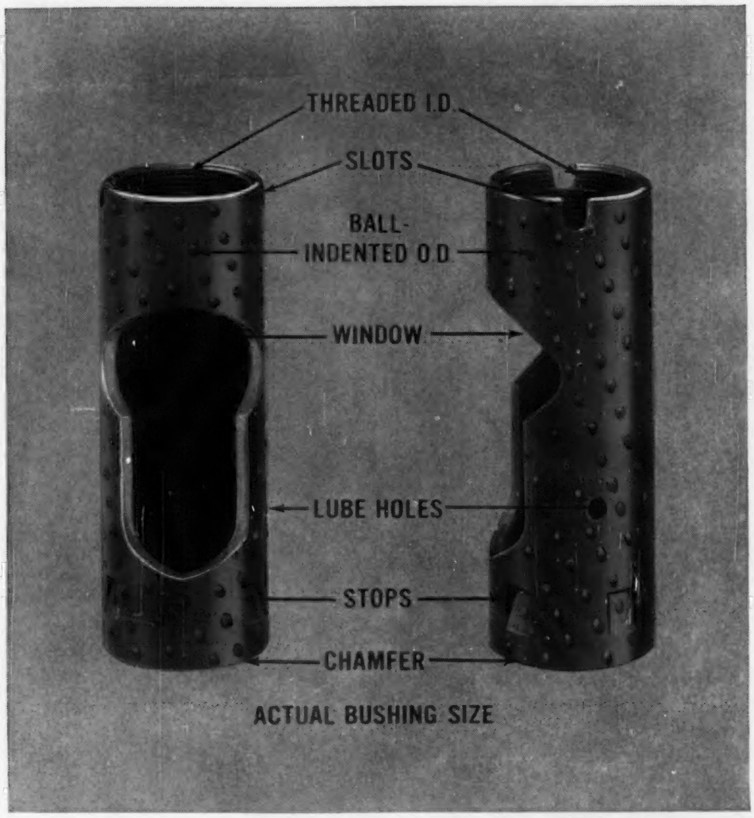
AE Exposition Progress Noted

FIRST invitations to exhibit in the first ASAE-endorsed Agricultural Engineering Exposition were mailed March 31, according to a report from Shea Expositions Corp., exposition managers. The event, announced in the February issue, will be held December 12 through 14 in the Palmer House in Chicago in conjunction with the ASAE Winter Meeting. This mailing, sent to a broad range of manufacturers, was timed appropriately to reach prospective exhibitors a few weeks after a news release announcing the event was distributed nationally. Nearly 100 requests for further information had been received already during the month of March. This response, reports the Shea organization, is an early indication of high interest. Further details concerning the exposition progress will be carried in future issues. Those interested in making arrangements for exhibit space may contact Agricultural Expositions Corp., One Gateway Center, Pittsburgh 22, Pa.

Agricultural Engineers' Handbook

COPIES of the Agricultural Engineers' Handbook, edited by ASAE members C. B. Richey, Paul Jacobson, and Carl W. Hall, and published by McGraw-Hill Book Co., Inc., are now available. Material in the new book has been selected from all branches of agricultural engineering, as attested by the range of experience represented in the impressive list of 41 contributors. Careful editing of the wealth of material contained has resulted in a concise, compact reference book, which should be a valuable companion to current agricultural engineering texts. We are proud to carry a review of this excellent handbook in our "New Books" column on page 205 and wish to express our congratulations to the editors and publisher for providing an agricultural engineering handbook, a service to meet a definite need.

"EXOTIC" BUSHING MAKES NEW STEERING DESIGN COME TRUE



INSIDE-OUT BUSHING HELPS PUT NEW STEERING MECHANISM INTO PRODUCTION! To perfect a new steering mechanism, an automotive manufacturer required a linkage component. Designers tried making it of machined steel, then plastic . . . both materials failed. But the unusual bushing shown at left, with a number of features F-M engineers helped designers incorporate, solved the problem. It is bronze-on-steel, formed with the ball-indented bronze on the O.D. so the bushing can accommodate sliding motion within the mechanism. A large window makes insertion of a ball socket easy during assembly. Design of the bushing also includes: stops near one end to hold a disc . . . a threaded I.D. on the other with slots for a locking pin . . . holes that supply lubricant to the outer surface. For the F-M customer, all these built-in features helped accomplish this result—easy, efficient assembly and success with a new design.

CAN F-M BUSHINGS SOLVE problems on your board or on your assembly line? Or perhaps a sleeve bearing, thrust washer or spacer? F-M, who makes them all, can provide the answer. F-M engineers, with a wealth of knowledge from years of experience, are available to help design the needed component. This complete technical assistance is one reason why these F-M products are widely specified for use in automobiles, farm equipment, construction machinery and many other products.

Additional information about bushings is provided in a Design Guide, published by F-M. Helpful literature is also available on sleeve bearings, thrust washers and spacer tubes. For your copies, write Federal-Mogul Division, Federal-Mogul-Bower Bearings, Inc., 11081 Shoemaker, Detroit 13, Michigan.

FEDERAL MOGUL

FEDERAL-MOGUL

sleeve bearings
bushings spacers
thrust washers

DIVISION OF FEDERAL-MOGUL-BOWER BEARINGS, INC.

Farm equipment today is bigger, bulkier, heavier than ever. As a result, tractor P.T.O. drive shaft assemblies are subjected to hours of rugged use and abuse. When it comes to wear like this, spline shaft drives just can't take it! Edges become burred, rough, worn. Shafts get "locked" in place. P.T.O. bearings often break.

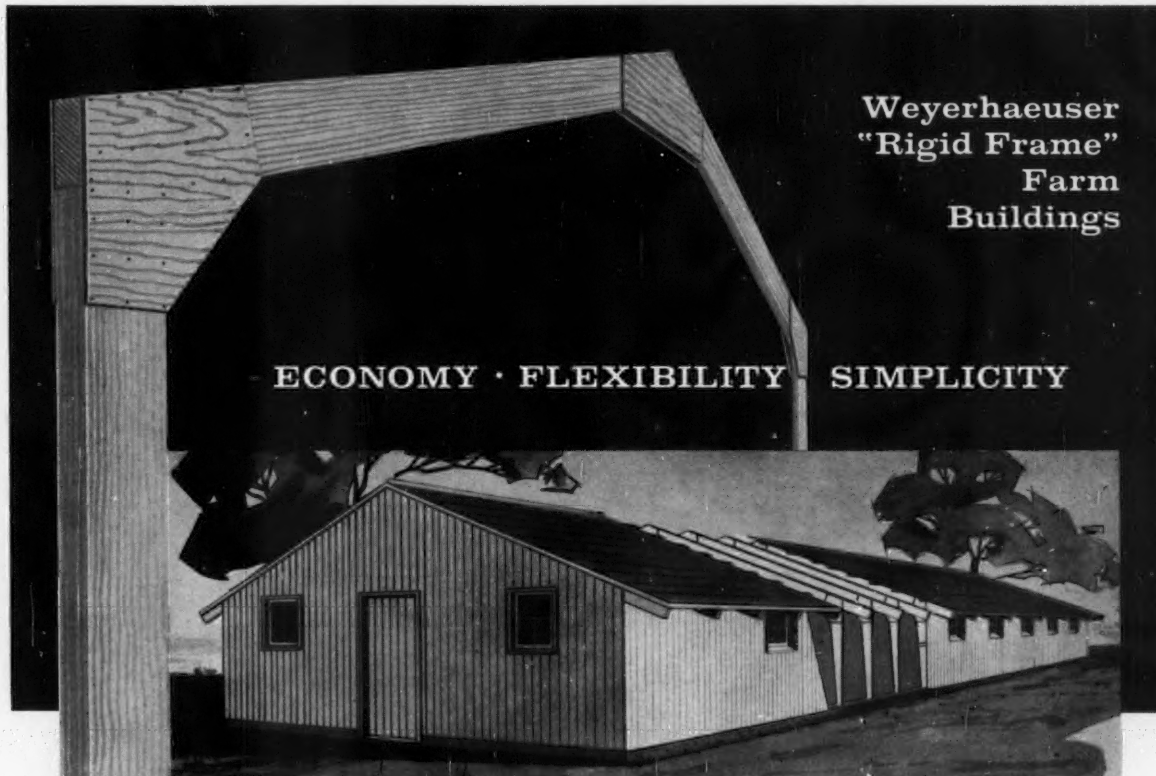
NEW BALL SLIP ASSEMBLY REDUCES P.T.O. THRUST FRICTION UP TO 90%!

Rockwell-Standard engineers have successfully solved the problem with an exclusive new Ball Slip Assembly that *reduces P.T.O. thrust friction up to 90% compared with spline type shafts for longer wear, more dependable service.* Several series of metal balls are held in grooves between the inner and outer shafts. This minimizes total metal-to-metal contact, keeps shafts "sliding smooth" for easy movement, improved wear-ability, trouble-free operation.

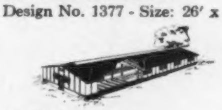
The unique Blood Brothers Ball Slip Assembly is proving itself in daily use. Many of the nation's leading farm equipment manufacturers have specified it for their units. It is typical of the new product developments that come from the continuing research of Rockwell-Standard engineers. Their designing skill and production experience have brought greater efficiency and economy to every major field of industry. Let them prove what they can do for you!

Another Product of... **ROCKWELL-STANDARD** CORPORATION

Universal Joint Division, Allegan, Michigan



FARROWING HOUSE
Design No. 1377 - Size: 26′ x 76′



These Are the Advantages of "Rigid Frame" Construction!

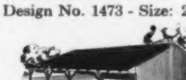
In these days of rising costs, the most versatile and economical structures are needed on the farm. That is why Weyerhaeuser designers and engineers develop their farm building plans on easily erected, rigid frame construction. Practical experience has proved the time and labor saving advantages of this technique. Clear spans provide post-free interiors – permit utilization of the entire inside area – pave the way for many different arrangements of working space – allow easy conversion for future farming needs. Strength is a prime factor of rigid frame construction. 4-Square framing lumber and easily cut plywood gussets form a strong arch that resists high winds and heavy snow loads . . . and insures longer building life. Every farmer should know about Weyerhaeuser "Rigid Frame" farm buildings.

LAYING HOUSE
Design No. 1472 - Size: 36′ x 104′

MACHINE SHED
Design No. 3225 - Size: 30′ x 48′

HOG FINISHING HOUSE
Design No. 1378 - Size: 40′ x 84′

BROILER HOUSE
Design No. 1473 - Size: 28′ x 132′



LOAFING BARN
Design No. 1140 - Size: 28′ x 48′

Weyerhaeuser Company
Lumber and Plywood Division

Write For It . . .

FREE

Weyerhaeuser Company
Box No. B-28
Tacoma 1, Washington

☐ **CLEAR SPAN DESIGNS**

Information on clear span and pole type construction for farm buildings, includes drawings and floor plans.

Report to Readers . . .

GIANT PLASTIC BAGS PROVIDE NEW MEANS OF STORING GRAIN

The products of two USA manufacturers have been combined into a new system that could revolutionize grain storage - even protect the nation's grain supplies from radio-active fallout in case of nuclear war. This is possible, it is claimed, for an investment in storage facilities of about 5 cents a bushel, in comparison with current building costs of approximately 30 cents. . . . . The new storage system employs huge vinyl plastic bags, or "sausages," into which the grain is blown by a portable, pneumatic grain-handling machine. (A 25,000-bushel bag now under test is 100 feet in circumference and weighs 600 pounds.) For aboveground storage, the only preparation necessary is to smooth the ground surface; no other support is required for the plastic bags. . . . . After a bag is filled with grain, a partial vacuum is created in it by reversing the air flow in the pneumatic machine. This not only collapses the roof of the bag, but the partial vacuum created within the bag reduces damage from insects and molds in the grain. . . . . The bags are impervious to weather changes and attacks by rodents, and if desirable they can be stored underground simply by excavating an area sufficient to contain them, which would provide safe, economic dispersal of grain reserves in case of war.

NEW BALER CLAIMED TO HAVE 17 TONS AN HOUR CAPACITY

A new hay baler produced in Britain is claimed to have a capacity of almost 17 tons an hour. Under exceptionally favorable circumstances, it is said to have produced up to 15 bales per minute. The machine is 8 feet wide and has a 56½-inch pickup reel with improved cross-feed to the bale chamber, feathering-action tines to feed the packers, and a new roller-mounted ram.

BLANCHING SPEEDS DEWATERING OF FRESHLY CUT GREEN FORAGE

A California AES agricultural engineer says that 6,000 pounds of water must be extracted from freshly cut forage to produce one ton of hay. By using a pressing process - placing the fresh forage between two flat plates and applying pressure - as much as 5,000 pounds of this water can be rapidly removed. . . . . This engineer further points out that, if the forage is blanched prior to applying the pressure, a larger proportion of the total water content will be removed. The amount of protein and dry matter contained in the liquid extracted will also be reduced. . . . . In case of alfalfa, losses of about 15 percent of the dry matter - 5 percent of the liquid removed - may be expected, together with a small decrease in digestibility and an increase in protein content of the pressed solid material. . . . . Maximum dryness achieved ranged from 43 to 38 percent, so that final drying prior to storage would be necessary.

PLASTIC LEVEES PROMISING FOR USE IN RICE FIELDS

A California AES irrigation engineer concerned with the many problems in the use of soil levees in rice production, including levee construction by large costly machines, levee maintenance, seedbed preparation, harvesting between levees, weed growth, etc., is directing studies on a new approach to reducing or eliminating such problems by use of plastic film supported by stakes as a levee. . . . . Early results from a field-scale installation indicate that plastic levees may have several advantages, such as seedbed preparation of the field as a unit before levees are constructed; harvesting the field in larger units, since the plastic levee can be removed prior to harvest; reduction in weed population, and minimum land area required for levees which means more land available for rice production. . . . . Further research is aimed at determining methods for mechanical installation of plastic film levees, techniques for removing the film from the field, desirable stake spacing and film thickness, methods of fastening the film to supporting stakes, and film durability in resisting high-velocity winds.

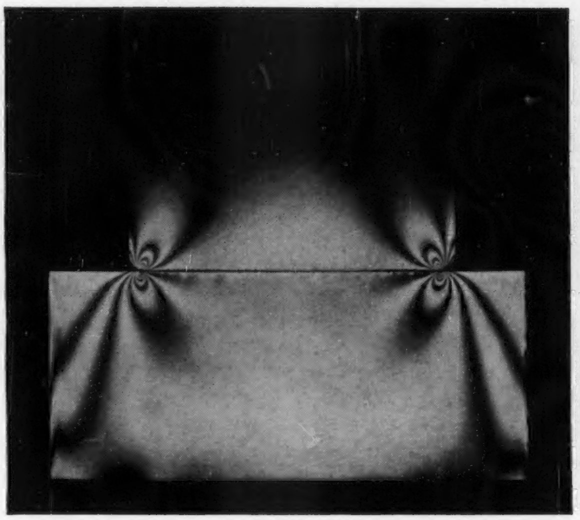
(Continued on page 168)

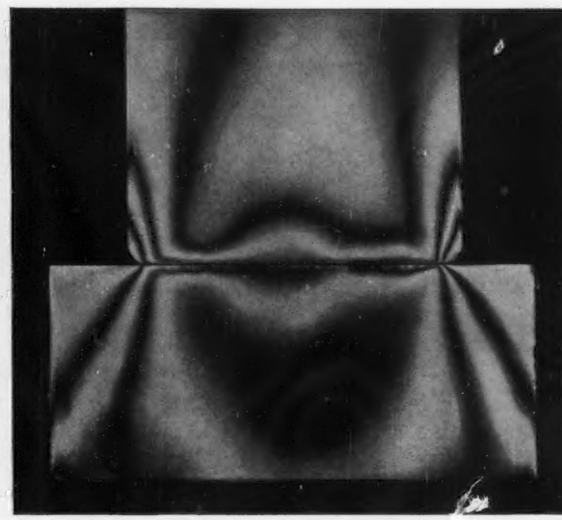
TEAR OUT AND PUNCH AS INDICATED FOR YOUR FILE
TEAR OUT AND PUNCH AS INDICATED FOR YOUR FILE

One in a series of technical reports by Bower

BEARING BRIEFINGS

ROLLER BEARING LIFE AND CAPACITY LINKED TO STRESS DISTRIBUTION





These reproductions of photoelastic studies contain important evidence for every engineer and designer concerned with the performance and selection of roller bearings. In these photographs, the alternate dark and light areas, called fringes, indicate not only the magnitude of stress but also the stress distribution. The photographs were taken by Bower Research Engineers during a study of stress distribution in roller bearings.

The subjects represent rollers and raceways of two roller bearings under identical loads. The illustration at the left shows a roller of conventional design. The illustration at the right shows a Bower "Profiled" roller. That is, the roller is precision ground with a large radius generated along the body of the roller—a predetermined and controlled distance from each end.

The conventional roller photo (left) clearly shows how, under load, stress concentration builds up in and near the roller ends. This is called edge-loading. Such areas of concentrated stress are the breeding grounds for metal fatigue and eventual bearing failure.

In the photo of the "Profiled" roller (right) stress lines can be seen uniformly distributed across the whole length of the roller and raceway. There are no points of excessive stress concentration, consequently no starting points for early fatigue. Such a "Profiled" roller exhibits a great advantage in improved load carrying capacity, a most important bearing requirement.

Under actual operating conditions, Bower "Profiled" roller bearings show a considerably longer life at higher speeds and under greater loads than conventional roller bearings.

Because of this, and of other Bower features to be discussed in later technical reports, we suggest that you consider the advantages of Bower bearings in satisfying your future bearing requirements.

★ ★ ★ ★

Bower engineers are always available, should you desire assistance or advice on bearing problems. Where product design calls for tapered roller bearings or journal roller assemblies, Bower makes these also in a full range of types and sizes.

BOWER ROLLER BEARINGS

BOWER ROLLER BEARING DIVISION — FEDERAL-MOGUL-BOWER BEARINGS, INC., DETROIT 14, MICHIGAN

NEW IMPLEMENT SORTS OUT FINE SOIL AGGREGATES TO IMPROVE THE SEEDBED

Ohio AES agricultural engineers and agronomists are experimenting with a new idea for a strip-tillage implement. From a narrow strip of ground this machine separates out the fine soil aggregates and places them at seed level, while coarse aggregates are left on the surface. A fine seedbed is thus provided for the seed and the drying rate around the seed is reduced. By placing the coarser aggregates at the surface, crusting is reduced and more resistance to raindrop impact is provided. . . . . Instead of breaking down soil structure to produce the fine portion of the seedbed, this new tool separates the fine from the coarse aggregates. In this way it is not necessary to till the space between the rows following the plowing operation and prior to planting, which fits in well with prevailing ideas of minimum tillage.

LARGER TRACTORS HAVE ADVANTAGE IN THE PREPARATION OF SEEDBEDS

One of the best arguments for larger size tractors, says a Cornell agronomist, is that their greater capacity makes it possible to complete field-tillage operations in less time. This means when soil moisture conditions are most satisfactory for working land or fitting seedbeds. If the soil is compacted to the point that the pore size is reduced, water intake into the soil, as well as drainage, is likely to become more of a problem. . . . . The tendency of tractor purchasers is to underestimate the power capacity that would best meet their over-all requirements.

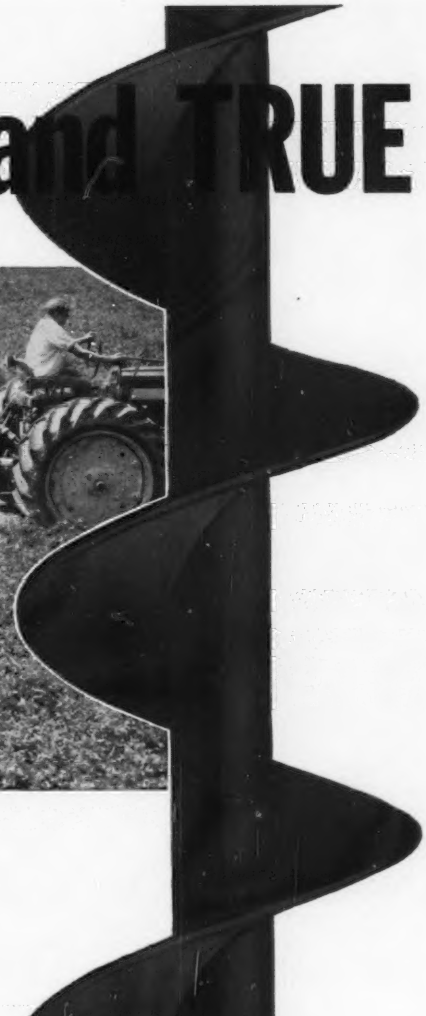
VERSATILE ONE-MAN FARM MACHINE MAKES SILAGE OR SPREADS MANURE

A new machine specially designed for processing silage and green feed for livestock has been demonstrated in Britain. It is a self-contained unit comprising a moving-floor trailer with flail-type forage harvester mounted at the rear. Driven by the tractor power take-off, it is designed for automatic cutting, loading, transporting and unloading of the green forage. . . . . The trailer is unloaded by a set of rotating flails that virtually blow the forage at high speed directly into the silo. If the cut forage is to be used for green feeding, a cross conveyor may be fitted for discharging it into feeding troughs. With the flail-cutting unit removed, the self-emptying trailer with high sides and cross-conveyor attachment will then serve as a self-unloading forage box. . . . . The moving floor can also serve as a high-capacity manure spreader. For such use an auger-spreader mechanism fitted to the trailer would replace the flail cutter unit.

SILO RESEARCH UNCOVERS NEW DATA ON STRENGTH AND COSTS

Michigan SU agricultural engineers recently reported results of a three-year study of silage pressure and silo capacity. One thing they discovered is that silage pressures may differ widely at various points on silo walls. Such variations, they say, could easily account for the collapse of silos in use. . . . . In this study the actual capacity of various silos was found by weighing each wagonload of forage as it was put into the silo. This revealed that in some cases the rated capacity was much higher than advertised by the manufacturers, and in other cases much less. On the basis of these results, some Michigan silo makers are said to be revising their capacity charts. . . . . This research, say the engineers, has emphasized the difference between silo capacity calculated on a cubic foot basis and the actual amount of silage that will pack into the space. In this study pressures on silo walls were measured with strain gages, which showed that, at first, wall pressure sometimes drops as the silage tends to settle toward the middle of the silo. However, final wall pressures near the bottom were always found to rise as settling slowed and stopped. . . . . These preliminary measurements are, for the first time, providing silo manufacturers with reliable data for deciding how strong to make large silos.

STRAIGHT and TRUE



NEW HOLLAND MODEL 33 CROP-CHOPPER hustles crops into its cutter head via Link-Belt heavy-duty, 12-in. diameter auger. Precision steel roller chain drive assures positive transmission of power.

Exactness of construction is just one of many reasons for designing with LINK-BELT augers

Straight and true! And Link-Belt augers are built to stay that way to assure years of smooth, vibration-free operation. Their strength and straightness result from strict manufacturing controls. Only *selected* steels are used to assure a smooth, accurately rolled product. And specialized forming machinery turns out uniform flighting *consistently*.

Link-Belt augers are available in a full range of diameters, gauges and pitches . . . with helicoid, sectional and many other types of flighting. Link-Belt also has a complete line of troughs, spouts, hangers, drives and other components. For further details, contact your nearest Link-Belt office. Ask for Book 2989.

15,396

LINK-BELT

FARM MACHINE AUGERS

LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants, Warehouses, District Sales Offices and Stock Carrying Distributors in All Principal Cities. Export Office, New York 7; Australia, Marrickville (Sydney); Brazil, Sao Paulo; Canada, Scarboro (Toronto 13); South Africa, Springs. Representatives Throughout the World.

Make choice hay faster!

Mow 30% faster with McCormick® "pitmanless" mower... cut curing time by 50% with IH rubber-roll conditioner

Mow and crush hay in *one* fast trip to save time and preserve feed value. You whiz along whisper-quiet with a vibration-free McCormick Balanced Head Mower and No. 2A conditioner to cut and condition 50 acres a day.

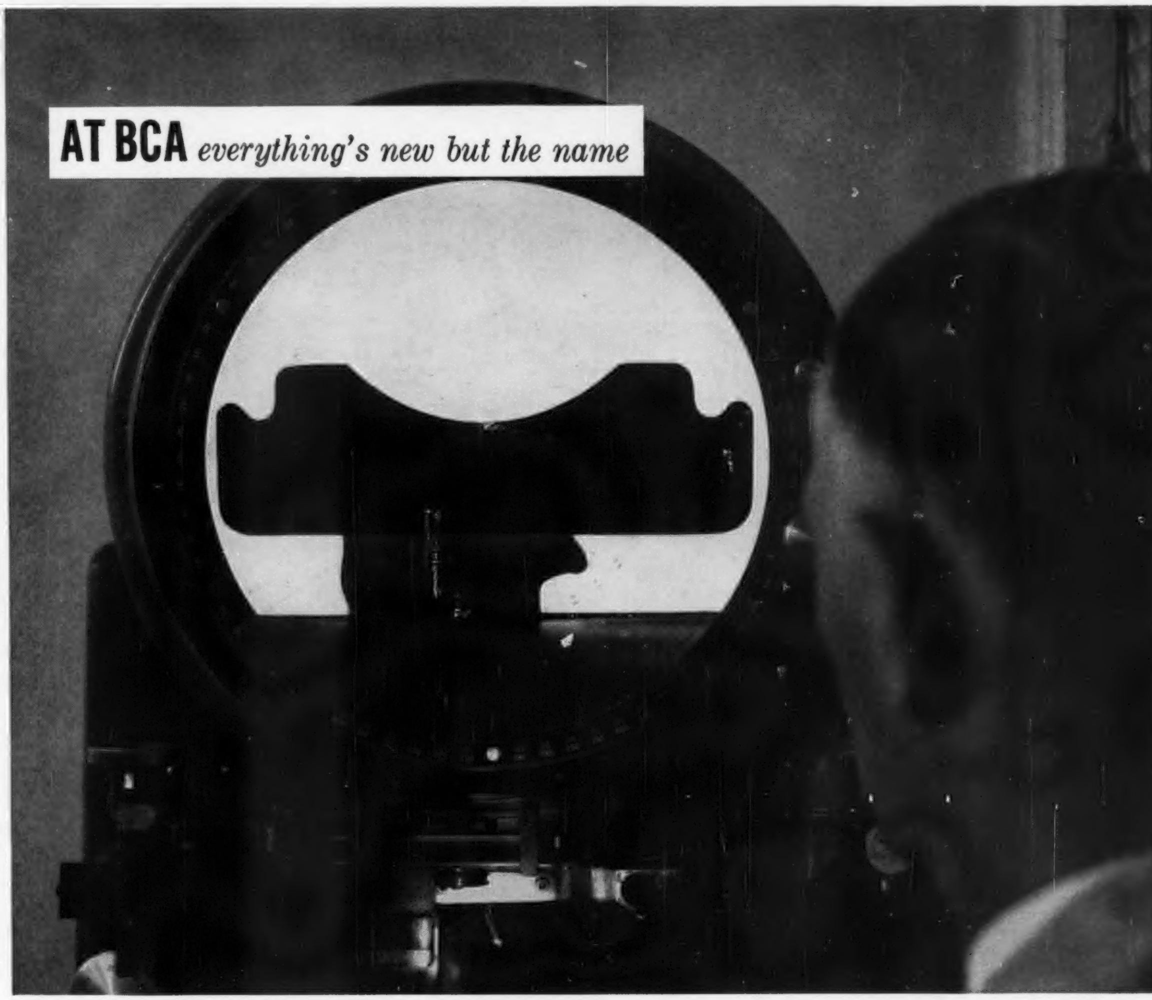
Faster knife speed and extra-short knife stroke let you cut clean in tough stands at speeds up to 7½ mph with McCormick Balanced Head Mower. Exclusive 100% cutting action eliminates unnecessary knife travel . . . cutting edges are always exposed for fast, smooth mowing. Save greasing time too with only one mid-day stop for lubrication. Available in two or three-point Fast-Hitch, side-mounted, and trailing models.

Crush as you mow to cut curing time in half. Rubber rolls on the McCormick No. 2A Hay Conditioner save millions of rich, tender leaves that crimpers pinch off . . . help hay cure to baler-ready condition hours sooner! Exclusive "cushioned crack-open action" gently cracks each stem—along its full length! This compacts pith cells and allows drying air to carry away moisture quicker. Flexing action of tough, truck-tire rubber makes IH rolls self-cleaning. And they're stone-proof too. These grooved rubber rolls sweep the windrow clean *without* a separate pickup—work almost silently. Cut haying time and boost feeding value with a McCormick mower-conditioner team!

See your IH dealer. He'll gladly show you revolutionary McCormick "pitmanless" mowers, and the big difference in hay conditioners—McCormick *rubber* rolls! Team up these haymaking partners to save time and extra feed value. Stop in for all the facts . . . set a date for a field demonstration.

INTERNATIONAL HARVESTER

World's largest manufacturer of farm equipment



BIG PICTURE—100 TIMES ACTUAL SIZE—

checks ball bearing geometry

BCA engineers take a close, "big" look at the configuration of inner and outer rings of ball bearings with this contour projector. It magnifies profiles up to 100 times actual size—makes possible extremely accurate measurements and control of all geometric characteristics of raceway rings.

This contour projector provides essential information for BCA research in developing new and modified bearing designs. It also evaluates the production performance of precision tools and machine set-ups by checking the profiles of production raceway rings against precise design specifications. This device is only one of many BCA quality control measures that help assure uniformly high ball bearing quality.

New BCA laboratory facilities also include a variety of specially designed testing machines that simulate actual or exaggerated operating conditions. On this equipment, bearings are studied under exact operating conditions of the customer's application . . . and tested to *exceed* his specifications.

BCA ball bearings for original equipment as well as replacement use are made in a complete range of types and sizes. They serve practically every kind of industry . . . automotive, machine tool, construction and agricultural equipment, to name a few. For complete information, for experienced engineering counsel on bearing applications, contact: Bearings Company of America, Division of Federal-Mogul-Bower Bearings, Inc., Lancaster, Pa.

BCA

BEARINGS COMPANY OF AMERICA

ball bearings

DIVISION OF FEDERAL-MOGUL-BOWER BEARINGS, INC.

Look to
FAFNIR
for leadership in
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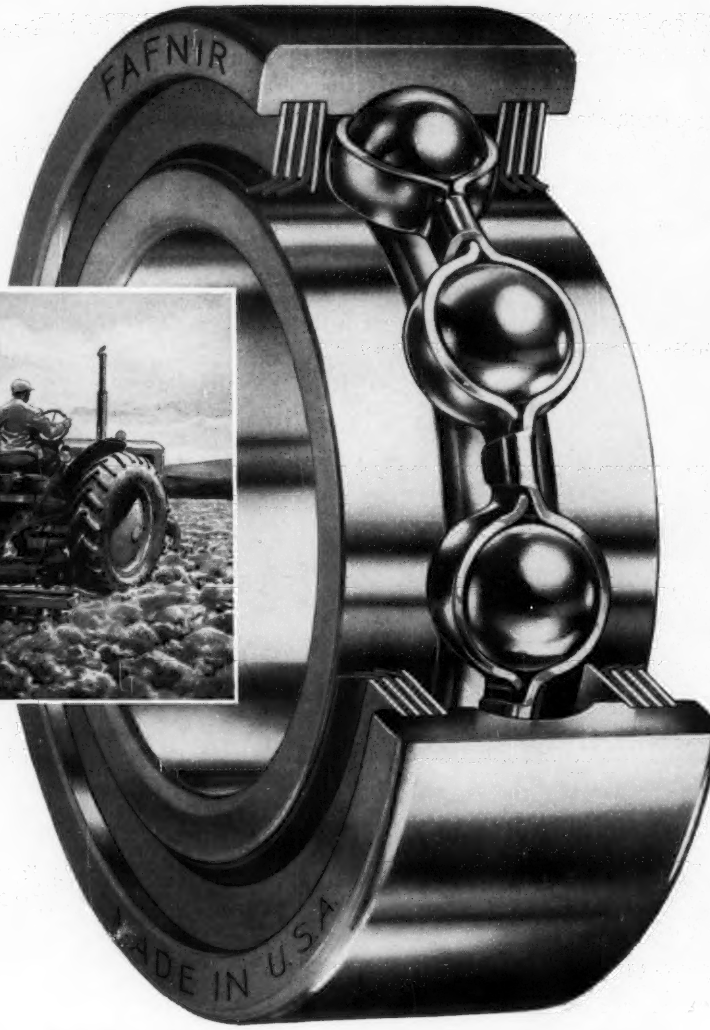

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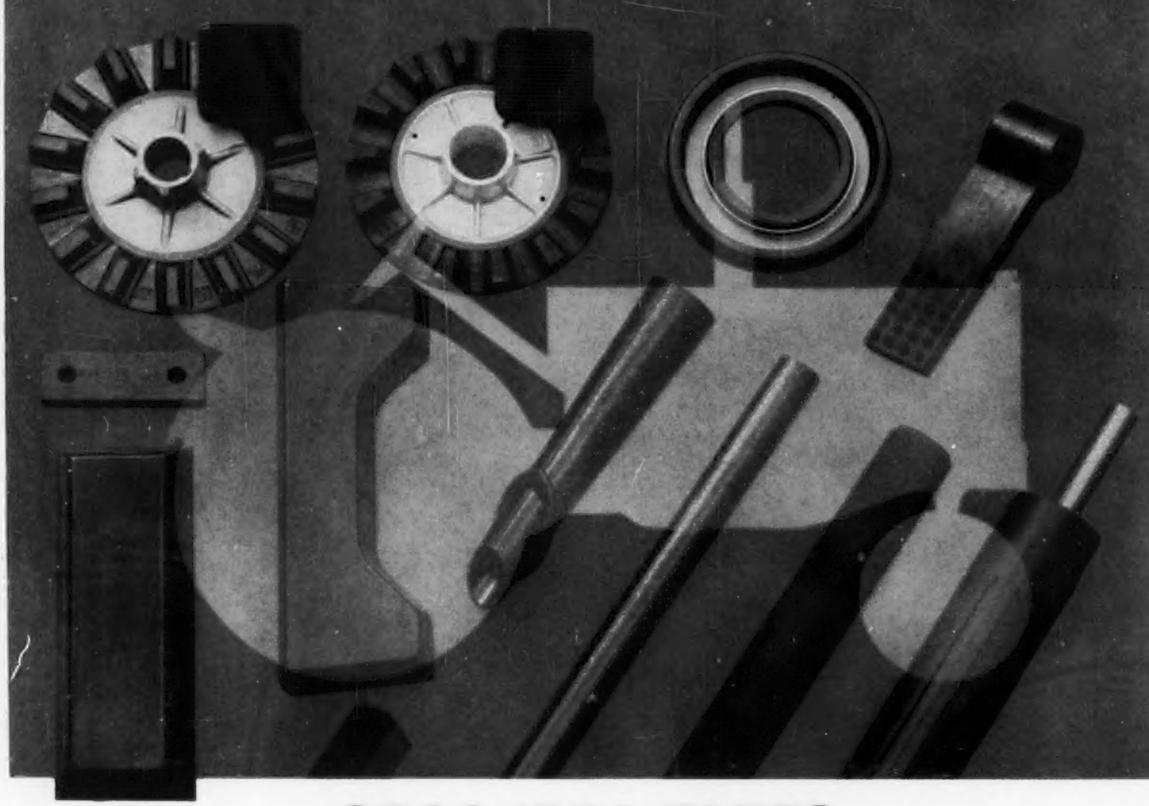

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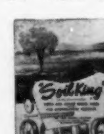

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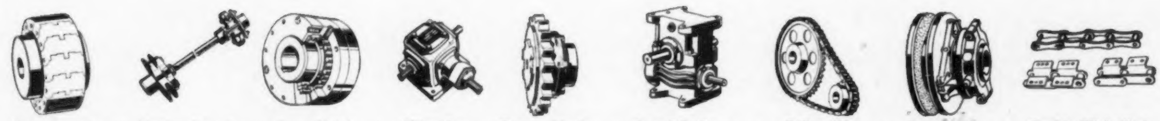

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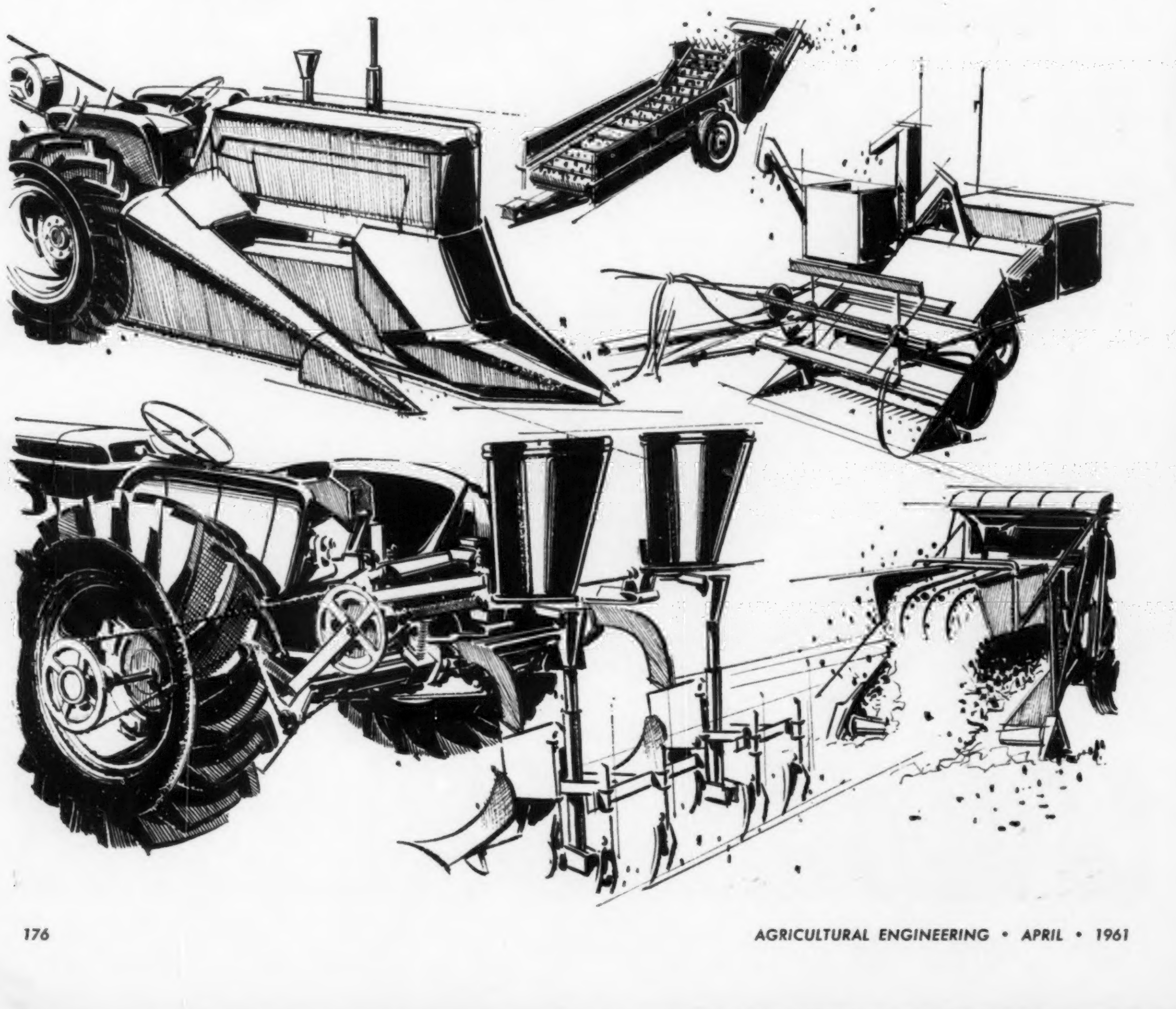

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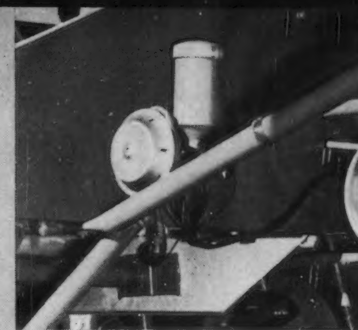

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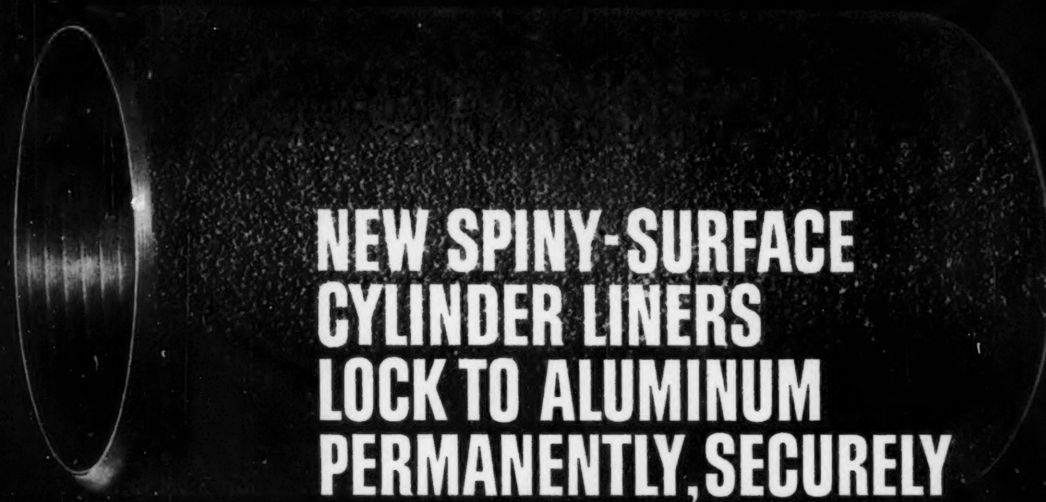

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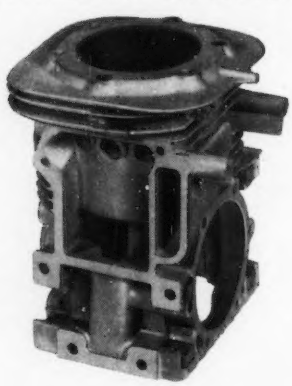

Now manufacturers of small engines can take advantage of the superior cast-iron cylinder liners used exclusively in the new die-cast aluminum passenger car engines.

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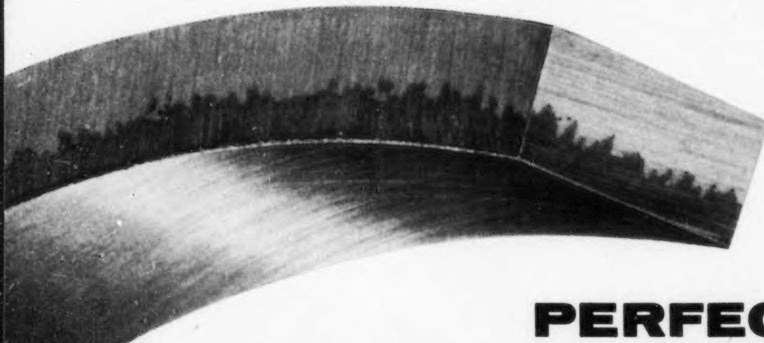

CROSS SECTION (magnified 4 times) shows how liner spines lock into the die-cast aluminum. Surface is created by centrifugally casting liners in permanent molds coated with porous ceramic material.

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Agricultural Engineering

April 1961
Number 4
Volume 42

James Basselman, *Editor*

Goals for Agricultural Engineering Research

G. Wallace Giles
Member ASAE

TWO announcements appeared in print last fall, one discouraging, the other encouraging. Discouraging was a report about the chemical industry synthesizing a biological material. Encouraging was a report about research bringing to light new discoveries about the mechanism of biological plants.

The discouraging report appeared in *Time* magazine and reported that scientists had tracked down many of the chemicals that give coffee its flavor. Scientists agree that "there is little reason to doubt that a synthetic coffee is on the way at a price about one-fifth of the real thing." Now such an announcement is not particularly shocking to people directly concerned with the production of food and fiber. We have had others . . . margarine took over the butter market . . . tobacco stems and artificial flavoring are being used in smoking products . . . synthetic fibers are competing keenly for cotton fiber market. These and similar substitutions are taking place at an accelerated rate because of the never ending competition for lowering costs and for producing products that will be in demand. People, industries, and nations are unrelenting in their efforts to better their position. They want to be distinctive. They want their products to be in demand.

We have moved from an agricultural society whose mission was to produce enough food and fiber into an industrial society where the quantity of production is not a challenging obstacle. In this kind of society distinction is achieved by adopting technologies that provide an acceptable product at a relatively low cost. We can only conclude therefore that, if the products of agriculture are to compete successfully with synthetics and other products here and abroad, we in agriculture must do likewise. We must provide acceptable products at competitive prices. In sum, we must commercialize agriculture to a far greater degree than we are now doing.

An encouraging announcement appeared recently in USDA's Agricultural Research publication on the detection of photo-reversible pigments that regulate plant development. This knowledge was developed by a team of scientists, one of whom was Karl H. Norris, an agricultural engineer.

This is encouraging for it is one of the marks of a new era of developing a better understanding of the mechanisms of live plants and animals. New knowledge such as this opens up a challenging new world as exciting as conquering the outer spaces. This is the kind of information agriculture needs to meet more successfully the kind of competition with which it is now faced.

It is the objective of this paper to outline some agricultural engineering research goals for providing the stimulus for a new mission; the direction for reaching out; to advance more rapidly tomorrow's technology applied to biological systems. All of this is needed so that agriculture and it products will be more competitive. First, I shall discuss some general concepts of the problem; second, four specific goals, and last, four research policies that are pertinent to the accomplishments of these goals.

General Concepts of the Problem

The plant or animal constitutes the heart of the agricultural industry. Both are actually factories designed to bring about desirable energy conversions. In this respect they are similar to the chemical factory for making synthetics. Fig. 1 illustrates the similarity of a few selected operations in a chemical plant for making rayon fiber for finishing with those in a biological plant for making cotton fiber for finishing. In the chemical plant cellulose acetate and acetone are combined and extruded from a spineret as a viscous solution. At this point the application of heat energy removes the solvent and fixes the molecular arrangement. In the biological plant solar energy is absorbed by the chlorophyll to change carbon dioxide, water and nutrients into cotton fiber.

The engineering problems of these two systems are equally similar. Generally they can be classified into two categories:

1. Manipulation and direction of energy to bring about a desirable chemical reaction; heat energy in one case and solar energy in another.
2. The engineering problems relating to the handling of materials and for the modification and control of the environment. For example, pumping the material in the one case and applying plant nutrients in the other.

This comparison illustrates agriculture's basic competition. Is agriculture to continue utilizing solar energy to bring about conversion to highly refined products such as cotton fiber, or is it to produce unrefined cellulose, as in the stalk, for the chemical factory to convert into a refined product? If the latter comes about, agriculture would be reduced further in its relative position.

There is also the possibility of utilizing the limitless energy of the sun to feed the people of the world by using synthetic chlorophyll. This is not farfetched because the production of one type of synthetic chlorophyll, was announced simultaneously this year by the American and German scientists.

If the chemical factory is a more efficient means of making the conversions, then it should prevail. But this has not been established and agriculture should not relinquish its commodities by default. The future belongs to those who work for it.

If we are to make the biological factory more competitive, agricultural engineers will

(Continued on page 193)

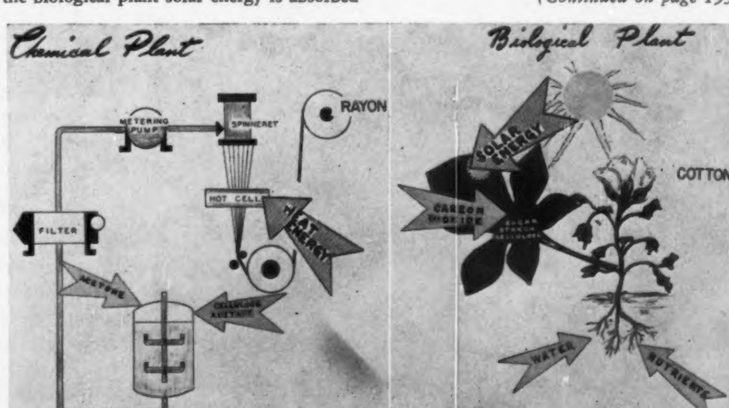

Fig. 1 Energy converters: *(Left)* chemical plant; *(right)* biological plant

An address given at a dinner sponsored by the Farm Equipment Institute during the Winter Meeting of the American Society of Agricultural Engineers at Memphis, Tenn., December, 1960.

The author — G. W. GILES — is head, agricultural engineering department, North Carolina State College, Raleigh.

Acknowledgment: The author is grateful to many of the faculty members of the North Carolina State College agricultural engineering department, particularly H. D. Bowen, F. J. Hassler, K. A. Jordan, Jan van Schilfgaarde, W. E. Splinter, and C. W. Suggs, who contributed wittingly and unwittingly to this paper.

Energy Requirements for Forming Hay Pellets

P. L. Bellinger and H. F. McColly
Assoc. Member ASAE Fellow ASAE

Industry-college research project offers opportunity for thorough study of significant pelleting problem with emphasis on pellet durability in handling tests

THE energy required to compress whole hay into compact units is relatively high. It is desirable to minimize the energy required to make such compact hay units and still maintain stability in handling. Pelleting at low pressures reduces energy requirements.

Preliminary investigations indicated that livestock can more easily eat small-diameter, low-density pellets than the larger, more dense ones. Butler (3)* and Hill (4) reported that best pelleting results can be obtained with hay below 25 percent moisture content. Bruhn (2) reported satisfactory storage of pellets below 25 percent moisture content.

The investigation report in this paper was conducted with hay below 25 percent moisture content, pelleted at average pressures of approximately 3,500 psi and less, in order to obtain relatively low-density pellets. In view of these considerations, the investigation was directed toward the following objectives:

1 Design and construct a research device which could be adapted, in principle, to a field machine for compressing long hay into pellets or wafers
2 Measure component and total energy required by such a machine to form and expel hay pellets in order that machine principles might be evaluated with regard to energy components. This might, in turn, aid in detecting high energy-consuming components of similar machines
3 Determine whether pellets made of whole alfalfa hay in a closed-end cylinder at 3,500 psi and lower will withstand extensive handling.

Paper presented at the Winter Meeting of the American Society of Agricultural Engineers at Chicago, Ill., December 1959, on a program arranged jointly by the Power and Machinery and Electric Power and Processing Divisions. The paper is based on a master of science thesis prepared by the senior author while attending Michigan State University, and is approved for publication as Journal Article No. 2661 of the Michigan Agricultural Experiment Station.

The authors — P. L. Bellinger and H. F. McColly — are, respectively, associate editor of *Successful Farming*, Des Moines, Iowa, and professor of agricultural engineering, Michigan State University, East Lansing.

Acknowledgment: The authors express their appreciation to the J. I. Case Co., Racine, Wis., for providing the research grant under which the study reported in this paper was based.

*Numbers in parentheses refer to the appended references.

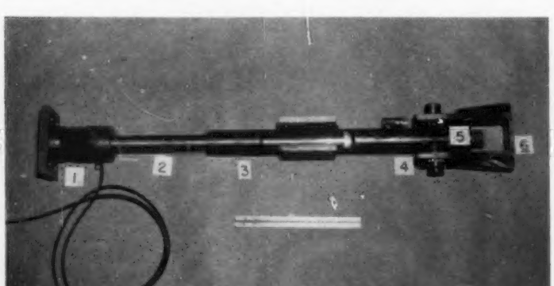

Fig. 1 Piston-cylinder assembly: (1) force transducer, (2) piston, (3) receiving cylinder, (4) pelleting chamber, (5) pellet in ejected position, (6) pelleting-chamber bracket

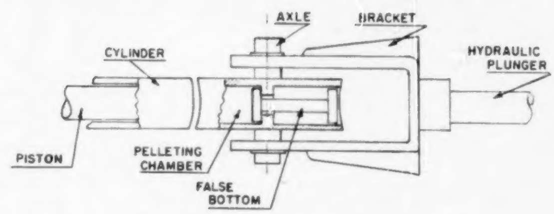

Fig. 2 Pelleting chamber assembly

LITERATURE REVIEW

Butler (3) determined the energy required to compress whole alfalfa hay in a hydraulically operated piston-cylinder device. He reported that compressing 80-gram charges of 12 percent moisture-content hay at 5,000 psi in a 2.40-in. cylinder required 3.7 hp-hr per ton of hay.

Richey (5) reported that an extrusion operation under conditions similar to those of Butler's investigation, required an additional 11.6 hp-hr per ton of hay.

The Russian researcher, Bezruchkin (1), showed that 1.3 to 10 percent of the maximum compressive force was required to eject grass meal pellets formed in a cylinder. Ejecting force requirements decreased as moisture content of the product increased.

TERMINOLOGY

In order to clarify the discussion in this investigation, the following terminology was established:

Pellet: a compact, cylindrical morsel made from whole hay, having a length-to-diameter ratio of approximately one.

Wafer: a compact, disk-shaped morsel, made from whole hay, having a length-to-diameter ratio less than one-half.

Pelleting Device and Its Operation

The piston-cylinder assembly shown in Fig. 1, was designed and constructed for this investigation. Principle components of the assembly included a 1½-in. diameter, casehardened, steel piston; a 1½-in. nominal inside diameter cylinder which served as a guide for the piston and as a receiving chamber for charges of hay, and a rotating pelleting chamber. A 1¼ x 8½-in. opening was milled in the receiving cylinder for feeding charges of hay.

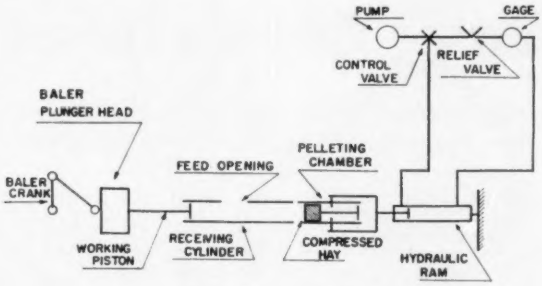

Fig. 3 Pelleting unit

The pelleting chamber (Fig. 2) was mounted on stub axles in a steel bracket. It could be rotated through 360 deg. It was equipped with a two-way, sliding, false bottom consisting of a solid shaft with a disk attached at each end. The false bottom was free to slide back and forth inside the chamber, being limited by a metal stop at midpoint to form a closed-end chamber with a moveable bottom. As the piston compressed hay into the chamber, the false bottom was forced against the stop inside the chamber. During the return stroke of the piston, the pelleting chamber was rotated 180 deg.

Another charge of hay was placed in the receiving cylinder. As the piston compressed the hay in the chamber, it ejected the pellet made by the previous stroke as it forced the false bottom to the opposite end of the chamber.

The above-described assembly was mounted in the chamber of a pickup-type hay baler (Fig. 3). By removing a section of the baler crank, the stroke was shortened to 16 in. The pelleting piston was attached to the plunger head.

It was necessary to provide a means of controlling the maximum pressure applied to a pellet. The pelletirg chamber assembly was opposed by a 4-in. hydraulic ram. During the pelleting process, a constant pressure was maintained in the ram by an electrically powered hydraulic pump. Maximum pressure on the ram was controlled by a relief valve in the hydraulic system.

The desired pelleting pressure determined the setting of the relief valve. When the force exerted by the piston on the hay in the pelleting chamber reached the value corresponding to the pressure setting of the relief valve, the valve opened preventing further increase in pressure on the ram. The chamber assembly, which was mounted on lubricated guide rails, was then opposed by the hydraulic force; it moved with the piston to the end of its stroke. This system provided a means of controlling the maximum pelleting pressure, regardless of the amount of hay in the chamber. It also acted as a safety device.

Power was supplied to the machine through the power take-off of a farm tractor.

Pellet Ejecting Device and Its Operation

It was desired to measure the forces and determine the energy required to eject pellets from the machine. Because of the relatively high magnitude of compressive forces, the transducer which measured them was not sufficiently sensitive to accurately measure the much smaller forces required to eject pellets.

A separate ejecting device was constructed. It consisted of a vertically mounted ram which could be moved downward by a hand crank and screw. After a pellet had been compressed, the pelleting chamber was rotated 90 deg so that the cylinder end containing the pellet pointed downward. By turning the crank on the ejecting device, the ram was moved downward against the false bottom in the pelleting chamber, ejecting the pellet. Tension springs raised the ejecting ram while the screw was being rotated counterclockwise.

All measurements and recordings of force and displacement were made with Brush amplifiers and oscillograph recorders, using SR-4 strain gages as sensing elements.

Four strain gage transducers were constructed to measure:

1 Force exerted on pellet by piston
2 Displacement of piston
3 Force required to eject pellets
4 Displacement of pellet ejector.

Transducers were calibrated and mathematical constants were calculated in terms of inches displacement and pounds of applied force per line of oscillograph pen deflection.

Pellet Tumbler for Handling-durability Tests

Durability of pellets and wafers was determined by subjecting them to treatment similar to the abuse which they might experience in normal on-the-farm handling operations.

The tumbling device shown in Fig. 4 was constructed for this purpose. It consists of a screen-covered trough mounted at midpoint on a fulcrum. The wooden trough 15 in. deep, 16 in. wide, and 10 ft long, can be tilted at angles of 60 deg in both directions of rotation.

Samples to be tested were weighed and placed in one end of the trough. When the trough was tilted to its maximum height, the restraining door at the upper end was released and the samples fell the entire length of the trough. Severe treatment resulted as the samples tumbled over cleats mounted across the bottom surface and struck the lower end. One such tumbling from maximum height to the lower end was considered a single cycle. The operation was repeated as many times as desired, according to predetermined specifications.

Durability of pellets and wafers was determined by weighing samples before and after subjecting them to a predetermined number of cycles. The portions of pellets which remained intact were removed and weighed. The weight of intact units after cycling was expressed as a percentage of the initial sample weight. *(Continued in May)*

Fig. 4 Tumbling device for handling-durability tests

Plastics in Soil and Water Conservation

T. W. Edminster and **C. E. Staff**
Member ASAE *Affiliate ASAE*

Requirements of the application and properties and capabilities of products considered

THE solution of many engineering problems in soil and water conservation is made difficult by exacting field conditions. Structures and materials must be able to withstand severe operating conditions such as wide ranges in temperature, exposure to intense sunlight, prolonged contact with soil acids and alkalies, and various levels of biotic activity. Mechanical damage from flowing water, abrasive bed loads, insects, rodents, animals, and even man, further tests the durability of materials. Materials must also be light and easy to transport to off-highway sites; they must be easily fabricated with a minimum of special equipment or facilities; and, above all, they must be low in cost to assure the economic feasibility of the project. Fortunately modern science is supplying new materials that can meet effectively many of these demands.

Plastics are one of the more widely used new materials. Nearly every production industry has found one or more important applications of plastics in its business. These vary from a coating or knob to a complete structural member. However, the substitution of a plastic for some more "conventional" construction material is possible only if the plastic has specific properties that will meet the requirements of the component in question. The engineer who makes the decision to shift from a standard material to a new material must be familiar with two sets of information: *(a)* the specific requirements of the application and *(b)* the specific properties and capabilities of the materials being considered.

PROPERTIES

What are a few of the properties of plastics that make them well suited to soil and water conservation jobs?

First of all, they come in limitless forms, ranging from sprays that can be applied from an aerosol can through films of varying thicknesses — as thin as ¾ mil (0.00075 in.) to 30 or 40 mils in thickness — in sheets, blocks, and rods of limitless sizes and shapes. They come in a variety of colors, lengths, widths, and flexibilities.

The two compounds that have been most widely used in agriculture are polyethylene and vinyl. While polyethylene is obtainable with a variety of physical properties depending upon the density of the resin, the low-density resin is most used in farm applications.

The newer high-density polyethylene resins have higher tensile strength, reaching 4,500 lb psi. However, the elongation is drastically reduced to under 20 percent. Its permeability is somewhat lower than regular polyethylene, and when used in pipes its higher bursting strength permits reducing wall thickness one-half to one-third for the same operating pressure.

Vinyl films may vary in properties depending upon their composition. They are composed of resins, plasticizers, colorants, lubricants, and stabilizers. The properties are adjusted mainly through selection of varying plasticizers. For agricultural purposes a plasticizer is chosen that is not affected by fungus, imparts good temperature properties, gives high flexibility, and a low extraction rate by water and soil.

A few of the properties of polyethylene and vinyl films being used for agriculture include the following:

Property	Flexible vinyl	Low density polyethylene
Specific gravity	1.20 - 1.35	0.91 - 0.92
Tensile strength, psi	2,000 - 3,000	1,500 - 2,200
Elongation, percent	200 - 300	600
Modulus (room temperature), psi	700 - 1,500	15,000 - 20,000

The water permeability of both vinyl and polyethylene films is low—essentially zero. Water vapor permeability is 1.2 for polyethylene and 4 to 13 for vinyl. This is measured in terms of grams per 24 hours per 100 square inches at 100 F and 90 percent relative humidity. Similarly, gas permeability, important in silage and packing applications, is also quite low.

APPLICATIONS

Plastic Pipe

The largest single farm use of polyethylene resins has been in the form of plastic water pipe. This pipe, when less than 2 in. in diameter, is shipped in coils. The larger diameters are shipped in straight pieces. The smaller diameters can be installed with a pipe layer attached to a conventional tractor. Many miles of plastic pipe have been used for delivering water to plant beds, livestock tanks, and small irrigated areas that are a considerable distance from a water supply. Some high density resin is now being used in this pipe application.

Irrigation Tubing

Another type of plastic pipe or tubing is also gaining in demand. This is the "lay-flat" or low-pressure flexible tubing. Made largely of black polyethylene, it is available in diameters from 2 to 18 in. Film thickness varies from 8 to 20 mils, depending on size and operating heads. These tubes may either be continuous for transporting water, or may be equipped with grommets, or plastic sleeves, spaced at intervals for discharging water into individual furrows.

Studies are under way at several locations on the use of large diameter (up to 36 in.) flexible tubes. These tubes are constructed from two or more layers of plastic between which is sandwiched a reinforcing fabric of nylon, fiberglass, or other high tensile strength fibers. Polyethylene, vinyl, butyl, and other materials are being tested for this use. In these large diameters a very effective low head, high-volume water transmission tube can be effected. Note the advan-

Paper presented at a meeting of the Pacific Coast Section of the American Society of Agricultural Engineers at Lake Arrowhead, Calif., April 1960.

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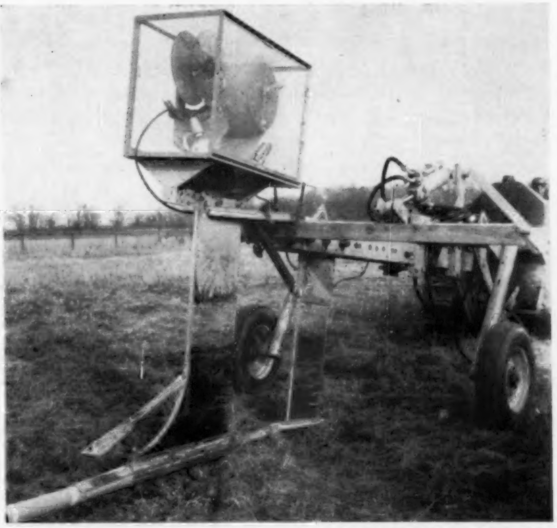

Fig. 1 Mole plow and equipment for installing plastic lining in mole channel. As plastic unwinds and moves down into ground, the edges are fed through a fastening-die that interlocks the pre-stamped tabs together with a "zippering" action. Completed tube is shown at lower left

tages: no seepage loss, no evaporation loss, no loss to phreatophytes, excellent hydraulic characteristics, and a minimum of earth moving to provide a base. Some of the disadvantages are restricted heads, liability to puncture or damage by falling rocks, bullets, or curious animals. Some of the early problems of separation and blisters forming between the layers seem to have been solved.

A full evaluation of costs and hydraulic characteristics is being developed by Lauritzen and Humpherys at Utah State University. Preliminary results indicate that with further development these large diameter "lay-flat" tubes will become an important item in irrigation water transmission systems.

Mole Channel Liners

Plastic pipe of another sort is receiving attention. This is the low-cost subsurface drain or lined mole channel. It was developed out of early studies by Schwab at Iowa State University in which he pulled perforated preformed semi-rigid plastic tubing into the mole channel behind the mole plow. With preformed tubing, the length that could be successfully pulled in was limited by frictional resistance. Kinks caused by sharp bends in shipment were focal points for collapse. The idea of forming a tube or arch-type liner as the mole is formed was the next step in development. Flat 15-mil perforated rigid vinyl or high density polyethylene sheeting replaced the preformed tubing.

Cooperative studies between the Agricultural Research Service (USDA), Caterpillar Tractor Co., Union Carbide Plastics Co., and personnel from various state agricultural experiment stations have resulted in extensive preliminary testing of the principle under a variety of conditions in the East, South, and West. From these studies there resulted a development program to provide:

- More positive closure of the sheeting into a tube
- Continued study of the load-resistance characteristics of these plastic tubes and possibilities of reinforcing them for certain conditions
- A positive automatic grade-control device to facilitate precision installation
- Basic hydraulic data on roughness and flow characteristics of water into and through the tubes.

This application for plastic may have an extremely important function in future drainage developments. Present experience shows that a 3-in. diameter lined channel can be installed up to 28 in. in depth for just slightly over 10 cents per lineal foot. With further improvement in equipment, grade-control devices, and plastics, it seems more than probable that lined channels 3 in. in diameter and at depths of 42 to 48 in. can be achieved. As depths increase, installation costs will increase; however, it is felt that this will not exceed 15 to 18¢ per linear foot. When compared to costs of $0.25 to $1.25 of some conventional drainage systems, it is apparent that where more intensive drainage is desired this approach provides a method at reasonable cost. Its role in interception drainage or to facilitate leaching, and as an adjunct to subsurface irrigation, all warrant continued study.

Rice Levees

Water control on rice fields is also an important problem for the agricultural engineer. The earth levee has been the standard structure for maintaining uniform depth and control of flooding water. Jack Corry, irrigation engineer at the University of California (Davis), studied ten rice fields in the area around Biggs, Calif. These fields ranged from

Fig. 2 A 4-mil black polyethylene film shows considerable promise as replacement for earth levee in rice fields

40 to 400 acres in area, the average being 181.2 acres. The area devoted to levees averaged 7.4 acres (3.8 percent) per field, the equivalent of 205 ft of 8-ft levees per acre. Such levees are costly to construct and to maintain. Serious weed growths develop on the levees and harvesting around them is so difficult that grain losses are high.

Preliminary studies on the use of plastic film levees have been conducted at Biggs, Calif., and Beaumont, Tex. It appears that they have these possible advantages:

- Require a minimum of land area
- Will not support weed growth
- Permit harvesting large areas because plastic levees can be removed before harvest
- May eliminate or reduce the large levee-forming equipment.

A few of the problems yet to be solved in this application include:

- Selection of a plastic formulation that can fully resist prolonged exposure to sun and temperature variations
- Development of an improved method of supporting the film on stakes
- Mechanization of both the placement and removal operations.

Development of a levee having a wire, nylon, or fiberglass cord imbedded in the top ridge would aid in applying tension to hold up the film. Thinner, lower cost films might be utilized with this type of support.

There is little doubt that the placement and pickup of these plastic levees can be fully mechanized. This will add further to the economic advantages that Corry has found in his early studies. Based on 205 ft of levee per acre and carefully estimating material, stake, and labor costs, he found an annual installation and removal cost of the plastic levee was $14.39 per acre. Similar studies showed that the cost of constructing, maintaining, and removing conventional earth levees was $6.01 per acre.

Saving in harvest time through removal of the levee was estimated to be one-half of the harvest cost, or $4.34 per acre. Based on the area of land that is returned to rice production when earth levees are replaced by the plastic levee, Corry showed an additional $4.00 return from the land so returned to production. D. C. Frinfrock, superintendent, Rice-Pasture Experiment Station at Biggs, estimates that approximately two sacks of rice per acre may be gained if a plastic levee is used to replace the soil levee, because the weed-seed population once eliminated by spraying or tillage may possibly be reduced by half. This contributes an additional $8.00 return per acre.

Corry summarizes the economics of the situation by comparing the cost of 4-mil black polyethylene film, stakes, and manual installation at $14.39 per acre with the approximate cost that could be spent on such a levee. This figure is the sum of the following items:

Per acre production from land formerly occupied by earth levees	$ 4.00
Per acre savings on harvest costs	4.34
Per acre cost of soil levee construction	6.01
Per acre savings from weed damage	8.00
Total	$22.35

Hence $22.35 less $14.39 results in a profit of $7.96, or approximately $8.00 per acre, or about 8 percent increase in gross income. It is little wonder, therefore, that the University of California plans a full-scale commercial farm study for 1960. It explains why H. R. Hudgins, of the Rice-Pasture Experiment Station at Beaumont, Tex., reported in a letter dated March 21, 1960: "The interest is so great I could not drop this work if I wanted to do so."

Irrigation Borders

If plastic film can be used as a substitute for earthen structures on rice fields, why should it not be effective in establishing irrigation borders? Many of the same advantages would apply, as follows:

- A minimum of land out of production
- Removal of an area that harbors weeds
- Improved harvest efficiency since the field can be operated as a whole.

Plastic border levees might also aid in rodent control since it would not provide the same refuge from flooding that earthen borders do. Savings in rodent damage could considerably offset much of the added cost.

The irrigation of level-bench terraces requires extremely precise finish grading and precise water control to guard against breakovers that may severely cut the back slope of the terrace. It is conceivable that where this method of irrigation is essential the addition of a plastic terrace-border edge would serve as a valuable guard against such breakovers.

With machine installation, such levees could be rapidly placed, used, and then removed to be installed on a new site. This material used for developing water-spreading lagoons in the spring might be reused for border levees during the irrigation season.

Irrigation Dams and Siphons

Plastic irrigation dams and siphon tubes have been in use for some time. Dams made principally of heavy vinyl sheeting supported on a frame quickly conform to the irregularities of the channel, giving a tight seal. Freedom from rot, light weight, and ease of cleaning provide many advantages over other types of flexible dams. While most siphon tubes are polyethylene, there are some tubes made of cellulose acetate. These tubes are available in sizes from ½ to 6 in. in diameter. As in any exposed application of plastic, only the heavily black pigmented resins should be used for this purpose.

Canal and Ditch Lining

The use of plastic films in canal and ditch lining is still in the early stage of development. Actually there are two distinct applications. One is the on-the-farm use in temporary field ditches. The other is a more permanent application as a buried membrane liner for canals and ditches.

Corry and Fox summarize the effectiveness of plastic films in meeting field ditch problems by saying: "Black polyethylene plastic film controls vegetation in irrigation ditches and provides improved water control by reducing or eliminating ditch-bank washouts, sloughing, and erosion." Over and above these benefits it controls the seepage losses through the canal, thus saving water and eliminating many drainage problems. The improved coefficient of roughness in a clean plastic-lined ditch permits use of a smaller cross

section for the ditch. Because of the reduced erosion hazard, side slopes can be made steeper.

The installation techniques have become standardized and partially mechanized. Corry reports an average rate for preparing and lining a ditch is 80 ft per man-hr.

In exposed linings, for ditches that are remade annually, a thin film is recommended. California engineers suggest 4-mil material which will permit its removal and reuse two or three seasons with minor repairs. Others suggest more care in ditch preparation and the use of films as thin as 1½ mils on a one-season basis. It appears that variations in soil conditions, flow velocities, nutgrass penetration damage, etc., must all be considered in resolving this question.

If the approximate retail cost of black polyethylene film is assumed to be one-half cent per mil of thickness per square foot, one may quickly calculate that a 4-mil liner which is 8 ft wide would cost approximately $16.00 per 100 ft of ditch. For a ditch requiring a 12-ft liner, this cost would be $24.00. To determine the economic feasibility of such a liner, a full cost-benefit analysis must be made. The details of such an analysis taking into account seepage rate, water cost, hours of ditch use, labor for ditch clearing, and reworking during season, etc., is fully covered in publications by Corry and Fox.

There seems to be little doubt that the practice has merit where high seepage losses, bank erosion, and sloughing and weed-growth problems combine to cause serious farm field ditch management problems, including water logging. Furthermore, mechanization for placement and removal of plastic liners and further improvement in their resistance to sunlight and mechanical damage will expedite their acceptance as a common practice.

The use of plastic as a permanent lining in major canals is another possibility. The physical characteristics of plastics fit them for use as buried membrane linings. For example, Grant Bloodgood assistant commissioner and chief engineer, U. S. Bureau of Reclamation, calls the Bureau's evaluation tests of plastics ". . . a step forward in the engineering program to reduce the costs of canal lining construction of USBR water resources development projects." He reported that on removal from ten-year-old soil deterioration tests most of the specimens of sixty plastic materials from fifteen manufacturers were in excellent condition. Their tensile strength was virtually unaffected.

Lauritzen points out that plastic films can be used to replace asphalt in the buried membrane type of linings. While either vinyl or polyethylene may be used, vinyl has several advantages. First, it may be sealed, seamed, or patched with a solvent, while polyethylene must be heat sealed. Vinyl also has greater resistance to impact damage during covering. Black polyethylene is more resistant to weathering and is more resistant to root and plant puncturing.

Continued research into types and methods of pigmenting plastic films and new selections of plasticizers have greatly improved the quality of films over the past five years. While 8-mil film is still the recommended minimum thickness for canal linings, there is the possibility that, with continued improvement of installation techniques and plastics, the 4 or 6-mil material can be recommended for certain permanent lining uses. However, even when the most effective plastic material is developed, a buried plastic membrane lining will continue to have many of the same inherent shortcomings found in conventional linings of this type; i.e., erosion and sloughing off of the cover, growth of weeds, and difficulty in cleaning, etc.

Pond Liners

Pond liners are similar to canal and ditch liners except for the shape of the lined area and the velocities of flow over the lining material. Because permanence is generally desired in reservoir linings, 8-mil material has been used for the most part. There are reports from southern California of 4-mil and thinner materials being used. The economy of using these thin films will have to be carefully considered as their length of service increases.

Considerable experience has been gathered throughout the country on the techniques of applying plastic pond linings. Work has been done in South Carolina, Virginia, New Jersey, Texas, Arizona, Utah, California, and New York, to name only a few. In each it was found that reasonable care in smoothing the pond bottom to remove sticks, stubble, sharp rocks, etc., will contribute to film protection. Lauritzen and others have confirmed the importance of filling the pond with water before applying the back fill cover. The water cushion eliminates practically all danger of film damage from dropping rocks or sharp gravel. It is generally agreed that side slopes must be three-to-one or flatter to retain a soil cover on a plastic membrane, particularly if there is much wave action or water-level fluctuation. Consideration is being given to a deep embossing of the plastic surface, removing the slick surface, and helping to retain the cover material.

(Continued in May)

Fig. 3 Irrigation reservoir in Utah being lined with 8-mil polyethylene film. Generally, it is recommended that the pond be filled before backfilling on the plastic. This minimizes damage to plastic. Area on which plastic is applied should be carefully smoothed. Note sharp object at upper right which is close to causing a break

Drying Shelled Corn by Conduction Heating

Glenn E. Hall and **Carl W. Hall**
Assoc. Member ASAE — Member ASAE

A comparison with convection heating

FORCED air drying, with or without heat, has been the principal method of drying farm crops. There are a few isolated studies of drying grain by means of conduction heating of the product, but these studies were limited.

The objective of this study was to determine the characteristics of drying by conduction heating of thin layers of shelled corn in comparison with convection heating. The principal variables studied were temperature, air flow, and moisture removal.

Review of Literature

Information concerning the use of conduction heating for the drying of grain is very limited. Robertson (5)* compared conduction drying, on a limited scale, with convection drying at 135 F, and found that after ten minutes the heated surface dried shelled corn at a faster rate than the forced heated air. He found that any desired moisture content which required more than 30 min at the 135 F temperature could be obtained in less time by using conduction drying as compared with convection drying.

Kelly (4) heated wheat by conduction and convection in a cement mixer, placed the wheat in other containers and forced air through the heated wheat for drying. He used approximately 18 percent moisture content (wet basis) wheat which lost about two percent moisture content, when heated to 150 F and exposed, in 6-in. layers, to 12 min of forced unheated air. The last 8 of the 12 min were used to reduce the temperature to a level safe for storage.

Procedure

Conduction heating was utilized in the investigation to dry 56 percent moisture content, dry basis (35.8 percent, w.b.), Pfister's Hybrid 244P yellow dent corn. The shelled corn was dried on a 0.04-in. thick steel plate suspended above an electric hot plate. The temperature of the heated steel plate was regulated by changing its height above the hot plate. The temperature of the heated plate was measured by a thermometer set in a ¼-in. piece of steel drilled out to the size of the thermometer bulb and placed on the heated plate. Approximately 75 grams of shelled corn in a single layer were used for each test. The samples for determining the loss of moisture, consisting of six kernels, were removed during drying for moisture determination. Air from a compressed air line was dispersed in a plenum chamber and then blown two inches above and parallel to the heated plate for several of the drying runs. Plate temperatures of 229, 189, 144 and 104 F were used with air flows across the plate of 25, 50, 100 fpm, and natural air current. Four runs were made at each drying condition.

The equilibrium moisture contents for the four plate temperatures were obtained by drying the shelled corn on the heated plate until no further significant amount of moisture was lost from the sample. An equilibrium moisture content of 4.30 percent (dry basis) was obtained for the 104 F plate, 2.39 percent (d.b.) for the 144 F plate, 1.06 percent (d.b.) for the 189 F plate, and 0.17 percent (d.b.) for the 229 F plate.

Corn of the same variety and moisture content was dried in single layers by convection heating. This was accomplished by forcing air at the rate of 235 fpm through the single layer of shelled corn. The same temperatures and times were used for the convection drying as were used for the conduction drying. The drying rate obtained with 235 fpm was not significantly different from the drying rate obtained with 92 and 130 fpm.

Discussion of Results

The drying rate periods consisted of four falling rate periods. This was in agreement with Hall (1) and Hall and Rodriguez-Arias (2) who first stated that there are four falling rate periods for corn above 25 percent (d.b.). A semi-logarithmic plot of the data obtained from the drying runs showed that the drying of shelled corn by conduction heating obeys the equation $M-Me/Mo-Me=e^{-k\theta}$, where different values of k apply to each falling-rate period.

In all cases, the natural convection current rising from the heated plate was sufficient to carry the moisture away as fast as it was being evaporated from the kernels in a single layer. When the corn was placed on the heated plate, there was an immediate drop in the temperature of the plate to a minimum and then a continuous rise to the original plate temperature. The forced air flows of 50 and 100 fpm kept the heated plate at a temperature below the desired level and resulted in a lower drying rate than was achieved without forced-air flow. The forced-air flow of 25 fpm did not increase the drying rate, although it did not lower the plate temperature as the higher air flows had done. The higher air flows had the same effect as using a lower plate temperature, therefore raising the cost of removing moisture. If the plate temperature had been maintained at the initial level during the entire drying process, the additional air flows may have aided the drying rate, but this would not have been consistent with the procedure used for removal of moisture by natural convection of air from the heated plate.

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*Numbers in parentheses refer to the appended references.

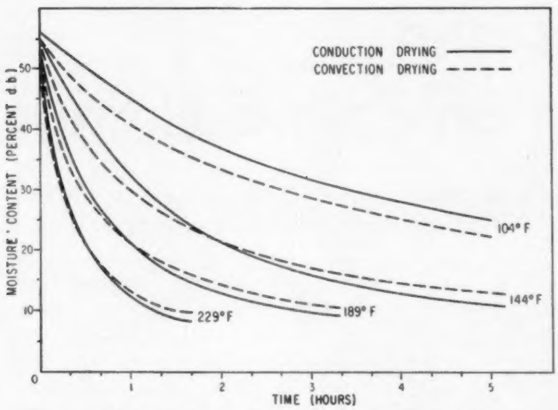

Fig. 1 Comparison of conduction and convection drying of shelled corn

A screen with 50 percent opening was placed on top of the kernels being dried to try to utilize more of the heat from the lower plate. The drying rate was increased, but excessive discoloration of the kernels resulted. When a plate was used over the kernels instead of the screen, the drying rate was increased still further with a greater amount of discoloration.

Fig. 1 shows that convection drying was faster at the beginning of drying than conduction drying, but was slower after a certain time had elapsed. For the 229 F temperature, conduction drying was faster than convection drying after 25 min; for 189 F after 64 min; for 144 F after 116 min; and for 104 F after 10 hr. The saving of time for drying from 56 to 18.3 and 15.0 percent moisture content (d.b.), which are the moisture contents generally accepted for selling and storing, respectively, are listed in Table 1. With the exception of drying to 18.3 percent (d.b.) at 104 F, conduction drying was faster than convection drying at the same temperature.

TABLE 1. PERCENT REDUCTION IN DRYING TIME BY USING CONDUCTION HEATING TO REPLACE CONVECTION HEATING FOR DRYING 56 PERCENT SHELLED CORN (DRY BASIS) TO:

	18.3 percent	15.0 percent
229 F	8.5	10.2
189 F	6.7	15.1
144 F	7.5	16.5
104 F	−14.6	3.2

Tests were made to determine whether the drying rate was affected by the position of the kernel. They showed that the drying rate of the whole kernel of corn was not affected by which side of the kernel, white or yellow, was in contact with the heated plate.

Kernels of 56 percent moisture content (d.b.) were cut up before and during drying to determine where the moisture was concentrated in the kernel and the effect on the drying rate.

Undried kernels were cut into three parts, W†, C, and Y‡, as shown in Fig. 2. It was found for 56 percent moisture content (d.b.) corn that the W side contained the highest moisture content (68 percent, d.b.) and the Y side contained the least (45 percent, d.b.). The C portion contained approximately 55 percent (d.b.). Other undried 56 percent (d.b.) kernels were cut into four parts, H, M, U and T, as shown in Fig. 2. These results showed that the T portion contained the highest moisture content with H, U and M following in decreasing order. The T portion contained 83 percent (d.b.), the H part had 66 percent (d.b.), the U section had approximately 52 percent (d.b.), and the M part had about 50 percent (d.b.) moisture content. Several other varieties of yellow dent corn were examined with similar results. When the kernels were cut into D, E and F parts, as shown in Fig. 2, the E portion had a considerably higher moisture content than the D and F portions. This was expected since the E portion contained most of the T section and the wetter part of the W side. For approximately 56 percent (d.b.) corn, sides D and F contained about 43 percent moisture content and the E part contained about 64 percent (d.b.). The next step was to cut up kernels during the drying process to determine the part of the kernel which dried the fastest and how the

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†W for white side. ‡Y for yellow side.

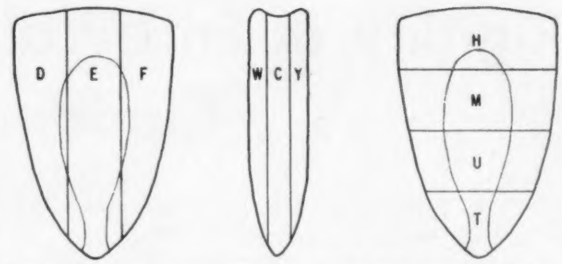

Fig. 2 Sketch of kernel as divided into parts during the investigation

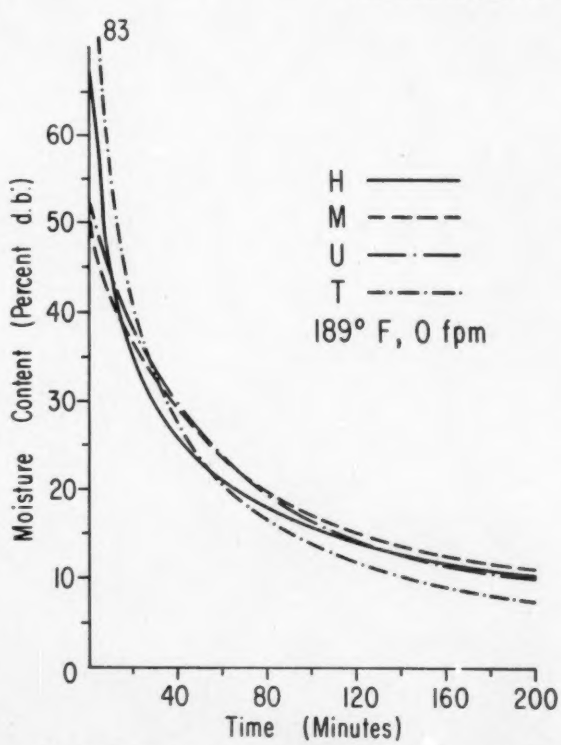

Fig. 3 Drying of shelled corn with yellow side against heated plate

Rigidity of End Walls and Cladding on Pole Buildings

H. T. Hurst and J. P. H. Mason, Jr.
Member ASAE *Member ASAE*

Study reveals that load support is not in direct proportion to amount of lumber used

STRUCTURAL research in farm buildings can be divided into two broad classifications: *(a)* the determination and evaluation of forces that farm buildings are expected to withstand and *(b)* the development and evaluation of designs from various materials which will resist these forces. While this study is of the latter classification, it is recognized that more fundamental knowledge of natural forces on buildings is badly needed. Building codes and standards which greatly influence farm building de-

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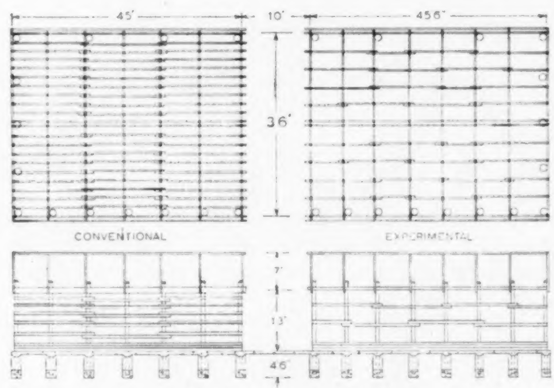
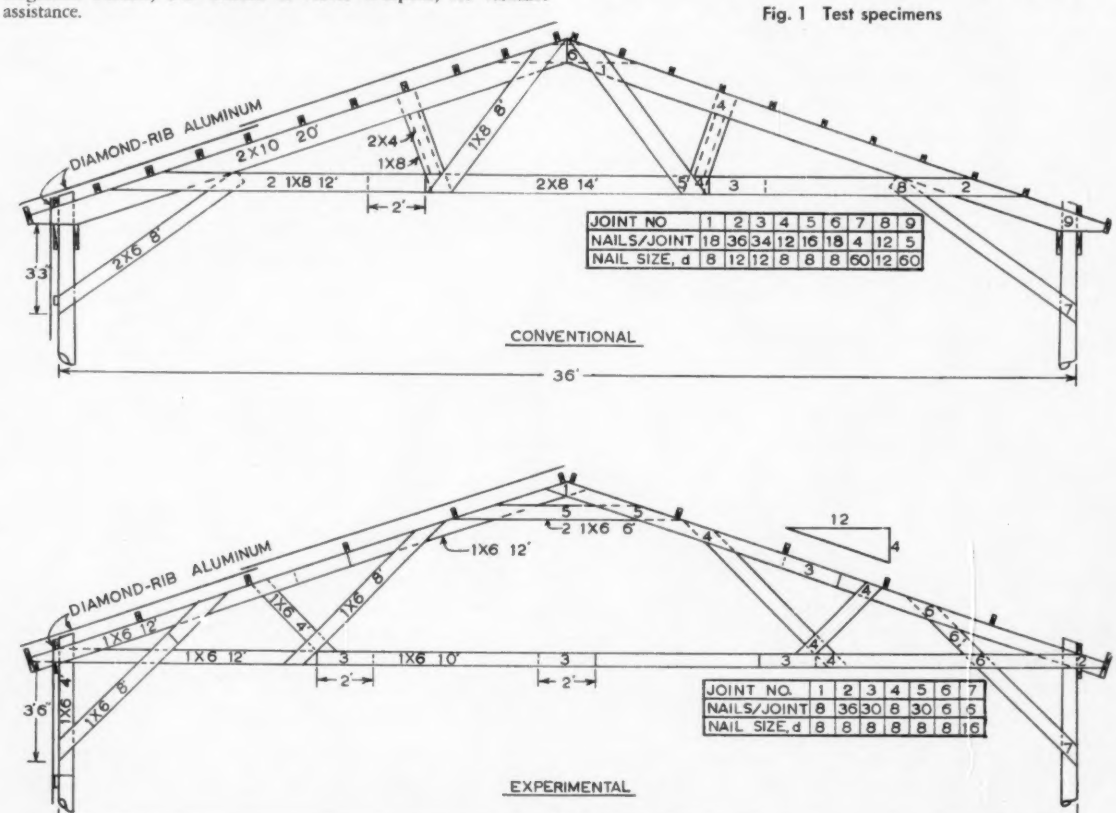


Fig. 1 Test specimens



JOINT NO	1	2	3	4	5	6	7	8	9
NAILS/JOINT	18	36	34	12	16	18	4	12	5
NAIL SIZE, d	8	12	12	8	8	8	60	12	60

JOINT NO.	1	2	3	4	5	6	7
NAILS/JOINT	8	36	30	8	30	6	6
NAIL SIZE, d	8	8	8	8	8	8	16

Fig. 2 Trussed rafters

signs can be no better than the information on which they are based.

It is common knowledge, especially with builders, that the skin or cladding of buildings greatly increases their strength and rigidity. Some designers have taken advantage of this fact, and in some cases eliminated the structural frame by forming the skin so that it will have adequate structural strength and still serve as covering. An example of this is the lock-rib type of building of one of the steel fabricating companies. Further examples of structurally utilizing the skin of buildings are the stressed-skin design of the Douglas Fir Plywood Association and the sandwich construction by the USDA Forest Products Laboratory. Other examples could be cited, but the point is that considerable thought and effort has been devoted to the application of this concept. Obviously the real test of any structural design is its ability to do the job for which it is intended at a minimum cost in terms of materials, labor and maintenance.

The designer may be comforted by knowing that the skin of buildings adds strength and rigidity, but until such knowledge is quantitatively evaluated, he cannot fully utilize it in designing more economical buildings. One very important problem is the lack of adequate design information of this nature. Therefore, the primary object of this study was to determine the rigidity attributable to the skin and end walls of sheet-metal-covered buildings to the extent possible with two 36 by 45 ft clear-span, pole-type buildings. One was of conventional design and the other was experimental. A secondary object was to study the structural behavior of the two buildings with each subjected to ultimate gravity loading.

EXPERIMENTAL PROCEDURE

Test Specimens

Fig. 1 shows the roof and back wall framing of two test specimens. The foundation consisting of one foot of concrete around bottom of poles and concrete floor slab was intended to fix the poles so that repeated horizontal loading could be applied with a minimum of permanent set (7)*. Nailed trussed rafters (Fig. 2) were spaced 7½ and 6½ ft in the conventional and experimental designs, respectively. Purlins and girts were spaced approximately 2 and 4 ft in the conventional and experimental designs, respectively. The purlins and girts were loaded at the quarter points; deflection of selected girts was continuously recorded at the center. Deflection of selected poles was continuously recorded at the floor and at 47-in. intervals. Both buildings were sided and roofed with diamond-rib aluminum (5). No. 2 southern pine and hardened screw nails were used throughout both buildings. All lumber was dressed except that from which the experimental trussed rafters were constructed.

*Numbers in parentheses refer to the appended references.

Pressure-treated southern pine poles with 5 to 6-in. tops were used throughout both buildings. Both buildings were knee braced from poles to trussed rafters wherever possible. (Table 1 and Fig. 2 provide complete nailing information.)

Tests Conducted

In order to evaluate the rigidity attributable to the skin and end walls of the two test specimens, the following step-by-step erection and testing procedure was followed:

1 Erected sidewall and roof frame, including knee bracing

2 Placed concrete floor slab

3 Conducted test 1 consisting of the following: *(a)* Applied simulated wind forces of 10, 15, 20, 25 and 30 psf to the back wall by cycling each force six times with a 3-min no-load period between cycles (Figs. 3, 5 and 6). The test specimen was unloaded at least five minutes between forces. *(b)* Wall-frame deflection was continuously recorded at 18 points throughout the test

4 Replumbed the test specimen and erected one end wall

5 Conducted test 2 which was a repetition of step 3

6 Applied diamond-rib aluminum siding to side and one end wall frame

7 Conducted test 3 which was a repetition of step 3

8 Applied diamond-rib aluminum roofing

9 Conducted test 4 which was a repetition of step 3.

Both test specimens were also tested to failure by simulated gravity loading (Fig. 4). The loads were applied at the quarter points of the purlins by a hydraulic system (10). The conventional building was tested first and the

TABLE 1. NAILING INFORMATION

Parts connected	Nails/joint	Size, in.
Splash boards to poles	2	4 x 0.177
Girts to poles	2	4 x 0.177
Rafters to poles	5	6 x 0.177
Purlins to rafters	2	3½ x 0.148
	1	5 x 0.177
Siding to girts	Every corrugation at ends and laps. Intermediate, every third corrugation, (8 in.)	1¼ x 0.163
Roofing to purlins (conventional building)	Same as siding	2 x 0.163
Roofing to purlins (experimental building)	Same as siding, except intermediate nailing at every second corrugation	2 x 0.163

Fig. 3 Simulated horizontal loading: *(Left)* Conventional building showing loading equipment. (Test 3 has been completed.) *(Right)* Conventional building (left) after test 4. Experimental building in background after test 3

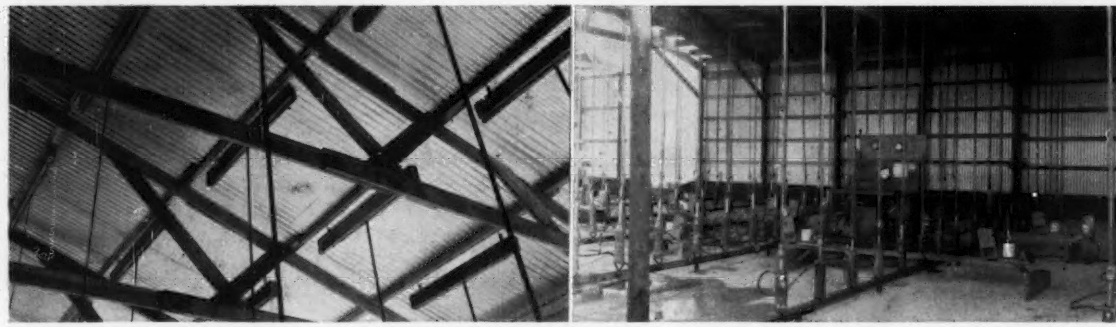


Fig. 4 Simulated gravity loading: *(Left)* Experimental roof design showing loading attachments. *(Right)* Conventional roof design subjected to simulated gravity loading. (Note continuous deflection recorders located under each trussed rafter)

loading started at 10 psf and was increased by increments of 5 psf. Each load was maintained for 10 minutes and the building was unloaded for 10 minutes between loads. The experimental building was tested in the same way, except that loading started at 5 psf. Throughout the simulated gravity loading, deflections were continuously recorded for all interior trussed rafters of both buildings at the crown, center of the bottom chord, and center of the front rafter.

DISCUSSION OF EXPERIMENTAL RESULTS

Horizontal Loading

Figs. 5 and 6 show typical data charts from one of the 18 continuous recorders used throughout all tests of both buildings. The temporary set and hysteresis effect for the one point is illustrated for tests 1 and 4. A sample of the performance of the two test specimens under horizontal loading is presented in Tables 2 and 3.

Before considering specific results it should be noted that the tests conducted were unrealistically severe, and the poles did not completely act as fixed-end cantilever beams. Since the skin and end-wall framing provide some rigidity, it is obvious that subjecting a pole structure with only sidewall frames to 30 psf is much more severe than applying the same load to a finished building. The set or deflection remaining in the test specimen after unloading for three minutes is given for 20 and 30 psf in Tables 2 and 3. This

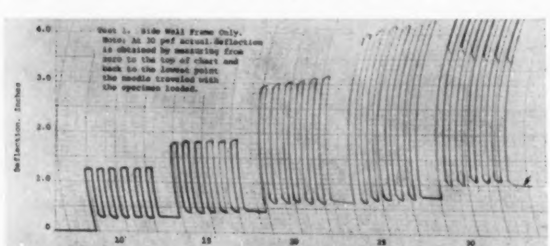


Fig. 5 Wall deflection of the conventional building 11 ft 9 in. above floor at center

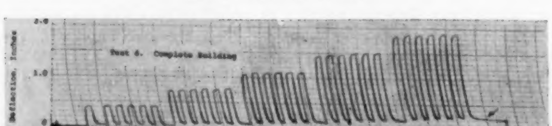


Fig. 6 Wall deflection of the conventional building 11 ft 9 in. above floor at center

is considered a very good indication of the degree of fixation of the poles, especially in test 1.

The set resulting from test 1 is attributed to the lack of complete fixation of the poles rather than stressing the frame beyond the elastic limits.

Using test No. 1, which was on sidewall loading alone as a basis, the addition of end-wall framing reduced deflection at the end approximately two-thirds for both buildings at 20 and 30 psf. The addition of siding reduced end-wall deflection over 97 percent in the conventional building and over 92 percent in the experimental building. The addition of the end wall and siding had practically no effect on deflection at 22 to 23 ft from the end.

The deflection at the end of each building and 45 ft from the end was approximately the same for test 1. The end poles received only one-half loads because the loading cylinders were attached to the girts which did not extend on both sides of the end poles. The poles 45 ft from the ends also received one-half loads, thereby accounting for the

TABLE 2. WALL DEFLECTION, CONVENTIONAL DESIGN, 11 FT 9 IN. ABOVE FLOOR

Test No.	Deflection, inches					
	End		22′ 6″ from end		45′ from end	
	Loaded	Unloaded	Loaded	Unloaded	Loaded	Unloaded
			20 lb per sq ft			
1	1.32	0.11	3.18	0.63	1.49	0.14
2	0.45	0.03	3.50	0.31	1.50	0.08
3	0.03	0.00	2.92	0.28	1.43	0.12
4	0.15	0.03	1.10	0.12	1.55	0.15
			30 lb per sq ft			
1	2.08	0.11	5.52	1.00	2.50	0.27
2	0.71	0.08	5.40	0.45	2.32	0.17
3	0.05	0.00	4.90	0.40	2.36	0.20
4	0.25	0.04	1.89	0.23	2.63	0.23

TABLE 3. WALL DEFLECTION, EXPERIMENTAL DESIGN, 11 FT 9 IN. ABOVE FLOOR

Test No.	Deflection, inches					
	End		22′ 9″ from end		45′ 6″ from end	
	Loaded	Unloaded	Loaded	Unloaded	Loaded	Unloaded
			20 lb per sq ft			
1	2.01	0.17	3.15	0.24	1.30	0.00
2	0.55	0.05	3.70	0.18	1.50	0.11
3	0.12	0.00	3.90	0.23	1.48	0.06
4	0.30	0.07	1.46	0.30	1.78	0.25
			30 ft per sq ft			
1	2.55	0.25	5.66	0.62	2.20	0.06
2	0.90	0.11	5.60	0.30	2.33	0.20
3	0.17	0.00	5.64	0.30	2.23	0.12
4	0.52	0.10	2.40	0.50	2.82	0.35

variation in the deflection at 22 to 23 ft from the end and 45 ft from the end in test 1. In some respects a more desirable loading arrangement would provide a full load on the poles 45 ft from the ends to simulate deflection at that point in a building of 90 ft or longer.

The addition of roofing produced significant rigidity throughout both buildings. The loads seemed to be distributed throughout the buildings regardless of where they were concentrated. For example, Tables 2 and 3 show that deflection at the end and 45 ft from the end was slightly more with roofing (test 4) than without (test 3) in both buildings, but deflection 22 to 23 ft from the end decreased 60 to 70 percent in the conventional building and 50 to 60 percent in the experimental building. It is also interesting to note that in test 4 deflection was greater at 45 ft from the end than at 22 to 23 ft from the end, even though greater loads were concentrated in the 22 to 23-ft area. This is a clear indication of rigidity attributable to end walls in conjunction with roofing.

Vertical Loading

Fig. 7 shows that the experimental roof frame deflected less than the conventional which required approximately 95 percent more lumber per square foot of floor area. The conventional trussed rafter failed (Fig. 8) in less than 10 minutes after a load of 20 psf was applied. The experimental trussed rafter failed (Fig. 9) within two minutes after a load of 25 psf was applied. The result of this study is concrete evidence of the great potential savings possible through better balanced structural design.

Perhaps neither design should be subjected to a permanent load of more than 10 psf even in an agricultural building. Yet the contractor who erected both buildings has built many of the conventional design in this area during the last decade, all of which have given excellent service, some having even supported cage layers during excessively heavy snowstorms in February and March of 1960. The above seems to indicate that, in addition to great opportunities in better balance of structural design, there is also a great need for more knowledge of the magnitudes and distributions of the forces of nature on buildings.

CONCLUSIONS

The following conclusions are based on data collected during the study and known to be valid for the two rather extreme designs described herein. The extent to which these findings generally apply has not been determined, but the stiffening effect of sheet-metal cladding is widely recognized. This study represents an attempt to quantitatively evaluate such building rigidity.

1 For horizontal loading of both test specimens, the end-wall framing *(a)* Reduced deflection at the ends 60 to 70 percent, *(b)* reduced set approximately 50 percent at the ends, and *(c)* Had practically no effect on deflection 22 to 23 ft from the ends.

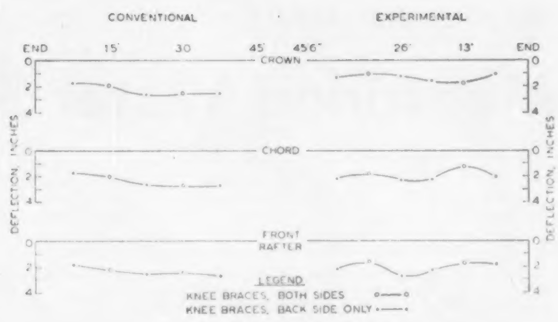


Fig. 7 Roof deflection, 20 psf

2 For horizontal loading in both test specimens, the addition of sheet-metal siding *(a)* eliminated set and almost eliminated deflection at the ends and *(b)* had practically no effect on deflection or set 22 to 23 ft from the ends.

3 For horizontal loading in both test specimens the addition of sheet-metal roofing *(a)* Stiffened the buildings throughout, *(b)* increased the deflection at the ends, and *(c)* decreased the deflection approximately 60 percent 22 to 23 ft from the ends.

4 The conventional roof frame, which utilized 95 percent more lumber than the experimental one, supported only 75 percent as much simulated gravity load. This indicates a substantial potential savings through better balanced structural design

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Fig. 8 *(Left)* Conventional trussed rafter failure in bending • Fig. 9 *(Right)* Experimental trussed rafter failure in column action

Measuring Water Surface Disturbances

T. F. Chen and J. R. Davis
Member ASAE

IN hydraulic experiments one often encounters the problem of describing the characteristics of an oscillating boundary surface separating two immiscible fluids. The motion of waves which occur on a water surface has been studied fairly extensively; however, in the case where a series of irregular small waves rise and disappear at a rapid rate, the observation of this system becomes difficult. The method outlined in this paper was developed for this type of system, for investigating the surface configuration of a water jet issuing from a smooth nozzle.

Method

Three principal properties of the surface of the water jet usually need to be determined: wave amplitude, frequency, and length. Measurements of these parameters were accomplished in the investigation reported in this paper by a simple manual operation and by utilizing an electrical circuit. The primary element in the circuit employed a fine, stainless steel needle, which was held stationary in the jet surface. As shown in Fig. 1, any contact between the needle and the water in a continuous jet closed the electric circuit. The registering element of the circuit—a time-interval meter—then indicated the number and duration of contacts. These data provide the information necessary to determine the three properties of the surface of the water jet.

The time-interval meter is capable of measuring and indicating the time interval between incoming electric signals and also accumulates the total time of a series of short time intervals. The shortest time interval that the meter measures is 0.1 millisecond.

The amplifier was necessary, however, to amplify the electric signals to the threshold level in order to operate the meter properly. As the length of the jet which comprises a part of the electric circuit increased, the increased resistance of the water created difficulties in operating the time-interval meter. Therefore, greater amplification of the incoming signals to the meter was needed. The amplifier is also a squaring circuit which converts the signal into a rectangular pulse of definite amplitude, rise and decay time. This provided positive triggering of the time-interval meter. The amplifier circuit used in these studies is shown in Fig. 2.

The stainless steel needle similar to a fine sewing needle was held in a fine hole through a plexiglass block. The

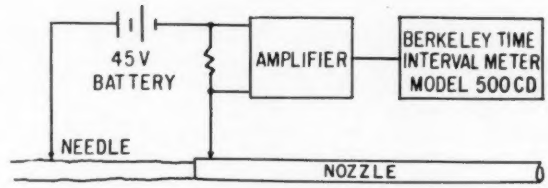

Fig. 1 General arrangement of apparatus for measuring disturbances traveling over a water surface

needle was raised or lowered by 0.001-in. increments by adjusting a micrometer mounted on the plexiglass block. The block was attached to a point gage, which was fixed radially to an annular plate. The plate had a circular opening of about 10 in. in diameter, through which the jet passed. The plate was mounted on a portable steel support which could be displaced in either a horizontal or vertical plane.

Measurement Procedures

The wave amplitude and frequency were obtained simultaneously, as follows: The needle was brought close to the jet surface by adjusting the point gage until the needle touched the wavy surface. After the peak of the wave was located approximately with the point gage, the micrometer was used to refine the reading to within ± 0.001 in. When a contact between the needle and the approaching jet surface was made, the circuit was completed and the time-interval meter gave a count. Thus, as the needle was lowered by the micrometer into the jet surface, an initial low count then represented the position of the peaks of the waves of greatest amplitude. The number of counts at that position represented the frequency of the waves of greatest amplitude.

As the needle was lowered further into the jet, it eventually reached the main body of the water jet, at which position the meter registered no counts. The difference in the micrometer readings at the first point of contact and the last point then represented the thickness of the disturbed sur-

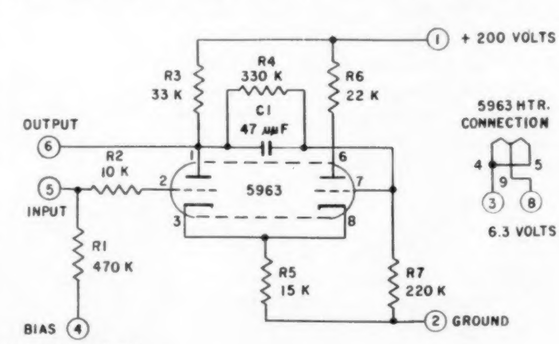

Fig. 2 Squaring circuit used in amplifier

An Instrument News Contribution. Articles on agricultural applications of instruments and controls and related problems are invited by the ASAE Committee on Instrumentation and Controls, and should be submitted to Karl H. Norris, instrument news editor, 105A South Wing, Administration Bldg., Plant Industry Station, Beltsville, Md.

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. . . Goals for AE Research

(Continued from page 179)

need to give more attention to the application of physical science to the internal mechanism of biological production and to the external operations and environment that influence this mechanism. Herein lies a tremendous frontier, the opening of which will attract the attention and capture the imagination of our younger generation.

Presently these young people are attracted strongly by the drama and the salaries of work associated with what they consider to be more dynamic industries of our day. The Sunday edition of *The New York Times* is a witness to keen competition for men skilled in the physical sciences applied to most everything except biological systems.

Why is this when biological systems constitute the biggest industry in the world?

The fundamental reason lies in the fact that we have not fully created nor articulated the more challenging opportunities in agriculture based upon a much broader vision. Our failure in fulfilling this responsibility explains why we cannot expect exceptionally high demand and salaries for our graduates.

SPECIFIC GOALS

To elaborate on the opportunities and responsibilities of engineering applied to biological systems, this paper will discuss four research goals.

Goal No. 1: Increase the Efficiency of the System

There are two general efficiencies with which agricultural engineers are concerned: biological and operational.

In the engineering view, biological efficiency involves the utilization of energy to bring about the desirable chemical reactions within the plant. Despite the fact that there is available a tremendous amount of solar energy, only a small part is absorbed. Furthermore, less than 3 percent and frequently less than 1 percent of the absorbed energy is used in the conversion in this plant. Even though this energy is free, how can we, if we don't do something about correcting this inefficiency, continue to compete, particularly when we do not have much control over it. This is to say that presently we cannot turn the energy on or off, nor regulate it as other industries do in their factories.

The operational efficiency pertains to the performance of operations that are external to but essential for good biological performance. These operations are either materials handling or environment modification in nature. The spacing of the plants, the application of water, and the cultivation of the soil are examples of operations that affect the environment surrounding the plant and consequently the response of the plant. The pumping of the water, transportation of chemicals, and the removal of the semifinished commodities can be classified as materials handling operations.

It is obvious that the factors affecting the biological efficiency and the operational efficiency are interrelated and interindependent. For the purpose of this paper, the biological plus the operational efficiency will be called "system efficiency."

This paper will now examine briefly the progress and opportunities toward increasing the biological efficiency, the operational efficiency and the system efficiency of two products: peanuts and eggs.

In these two examples the biological efficiency was calculated using traditional terms, as pounds of peanuts per acre and eggs per hen. The operational efficiency was computed using acres per man-hour and hens per man-hour; the system efficiency by pounds per man-hour or eggs per man-hour. Man-hour figures were used as a criterion of the operational efficiency because labor is a most costly and dominating input. Over a 15-year period, 1940-1955, the cost index based upon the 1947-1949 period has risen 300 percent for hand labor and 106 percent for machinery, and dropped about 5 percent for the average of electricity and gasoline.

The first example is peanuts and is illustrated by Fig. 2. Although the values are for North Carolina, they will serve to illustrate the points discussed. The values are recorded as a percentage of the 1939 figure. From 1939 to 1956 the acres per man-hour increased modestly. The yield per acre remained fairly constant. The pounds per man-hour rose to about 150 percent.

In the next decade the system efficiency can be increased to approximately 3800 percent by increasing the acres per man-hour to 0.1 from 0.02 and by increasing the pounds per acre to 6,000 as compared to 1,500.

It should be possible to achieve 10 man-hours per acre. The fact that the fruit is at the lower part of the plant and underground should not be a great obstacle — perhaps even an advantage. It should be possible to achieve 6,000 lb per acre through genetics, nutrition and environment modification along with more effective use of solar or a substitute energy. Our professional contribution towards achieving an increase in the biological efficiency must be in the modification of the environment and the effective utilization of energy; for these are the engineering factors, the manipulation of which can affect the response of the biological plant advantageously.

The second example is egg production and is illustrated in Fig. 3, the three lines of which are similar, namely percentage change in hen per man-hour, eggs per hen, and eggs per man-hour. It should be noted that from 1941 to 1960, called the "hand era," considerable progress has been made in the acceptance of methods for increasing the acres per man-hour and increasing the productivity of the hen. The combination of these two has increased the over-all system efficiency by more than 100 percent. Let us look now to the future, however, and to the period from 1960-70 marked "machine era." Through improving the external operations, the hens per man-hour can be increased to three. Through genetics, nutrition and environmental modification and control, the hen's productivity may reach 365 eggs per hen per year. The combination of these two, if properly coordinated and programmed, should produce a system with an efficiency of 1630 percent compared to 0 percent in 1941.

These two products (peanuts and eggs) were picked as examples. A similar chart of progress and opportunities could be provided for most of our agricultural products. The goal is to increase the system efficiency as projected and to do this by giving attention to improvement of both the biological and the operational aspects.

Consideration of this goal should not be left without mentioning some of the operation's opportunities. In each of these examples the next ten-year period was labeled the "machine era." But to achieve the efficiencies as projected, the next ten years will also need to be an "automated era," that is, one of replacing human judgment and physical efforts.

In the early days, preciseness was accomplished by the coordinated action of the human eyes, hands and muscles directed by the brain. Over the years we came to recognize this as too slow and expensive. Machines replaced these hand operations and gave the operator more power to accomplish the job more quickly, but frequently quality was sacrificed. In many instances, also, judgment is still required in positioning and accuracy of performance is poor. An example would be the steering of the machine, in which an operator's time and effort are used inefficiently, when he does little but steer a machine back and forth across the field, and does a poor job at that.

Another example of automation is the application of water for irrigation. A clever arrangement to do this job is practiced on a Texas cotton farm. The flow of water from the lateral ditch into the row is regulated by a gate controlled by a solenoid. At the opposite end of the crop row a tensiometer is imbedded in the soil. When it becomes saturated a battery-operated radio transmitter sends a signal to a receiver attached to the solenoid gate. The receiver in turn directs a current through the solenoid causing the gate to be closed. It is apparent

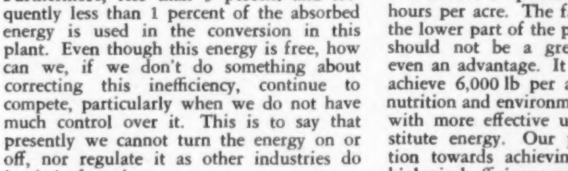


Fig. 2 Chart illustrating the efficiency of peanut production

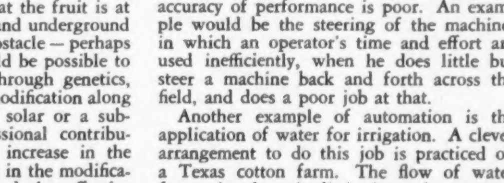


Fig. 3 Chart illustrating the efficiency of egg production

. . . Goals for AE Research

that physical labor and human judgment are reduced considerably.

There are many other opportunities in agriculture to apply automation—the planting of the seed more precisely and the picking of lint cotton without trash and fiber damage, for example.

Goal No. 2: Develop More Powerful Operations

Powerful operations are defined as those that are carried out effectively and quickly by use of effective means to get the job done when it needs to be done. They may not be necessarily the most efficient nor the cheapest. Take boll weevil control as an example; the criterion for success in this particular operation is the dependability and the quickness with which one can get the desired kill or control. As many know, the search is on for more powerful chemicals and methods, as, for example, systemic poisoning. Initially in this research, cost is not a factor; the effectiveness or quickness is the criterion. If this criterion is achieved, cost-reducing manufacturing procedures for the chemical and application techniques are then developed. Engineeringwise, our responsibilities are to reach for more powerful means including the method of application.

For example, the only physical forces that have been utilized to any extent in the application of pesticides are inertia and gravitation. On the other hand, there may be tremendous opportunities for utilizing electrical and thermal forces. These of course need to be investigated in cooperation with such things as particle sizes and external adherence or internal absorption.

Some say that the present-day cotton picker is a monster and unadapted. I would agree that it may be crude in the technique of removing cotton but it is certainly not too powerful. We need to develop completely new principles and concepts of harvesting with minimum consideration to the amount of energy expended and with maximum consideration to preservation of quality and getting the job done quickly. We must remember that we are competing with a factory that produces a more uniform, refined product with a high degree of automation.

There is another justification for developing operations that call for more power. The younger generation has a driving desire to be associated with operations that are carried out quickly, easily and effectively. Time-consuming operations with unpredictable results are not satisfying to this younger generation. We must provide more powerful operations if agriculture is to attract the young men who are superior intellectually.

Goal No. 3: Insure a Dependable Quality and Supply

The processors and manufacturers that utilize biological material in their operations must be assured of a dependable supply of an acceptable, uniform quality. They cannot plan and execute their operations effectively without it. If we in agriculture do not provide this dependability, industry will be forced to use more of their semi-finished synthetic products as for example rayon and to produce new synthetics.

Since the problem of dependability in agriculture actually starts with the seed, we might use planting as an example. Our aim is to provide the means whereby the seed can develop its potentialities uniformly and fully. One of the means is moisture.

Approximately four gallons of water is needed to germinate the seed planted on one acre. Yet it takes 27,000 gallons for one application to assure successful germination. Four gallons is a small quantity and always present, but the means for getting this amount of water and the seed together without irrigation is not present and most certainly not fully understood.

Another example of the lack of control in agriculture is the fruiting characteristics and harvesting date of cotton. One variety may set its bolls rather quickly, while another more gradually. To challenge us further, the plant may produce enough blooms to yield at the rate of 7 bales per acre. While the causes may be many and complex, environment is a factor. What then are the relationships between environment and fruiting? If these relationships were known, the door would be open for utilizing the forces and materials in nature to achieve a dependable volume and quality supply presently way beyond our experience.

These are only two examples of the control agriculture needs if it is to compete with the control other industries enjoy.

Goal No. 4: Program and Coordinate the Operations

Agriculture is beset with too many variables that cause uncertainty in the timing of operations. The variability in the fruiting and harvesting of cotton and in the germination of seed has already been mentioned. With such variability one cannot program accurately. If we are to compete with synthetics, we must do something to modify and to bring under the control of the manager the variables, particularly environmental, that now plague us. I refer to such things as solar radiation, moisture and temperature.

In the matter of coordination, I am thinking of adjustments in the techniques and principle of a single operation that are advantageous to a subsequent operation and consequently to the whole system.

The concept of an integrated food factory for producing peanut butter may be used to illustrate this point. The production of the peanut butter starts when the seed, water, oxygen and plant nutrients are fed into a farm field factory and ends packaged and ready for distribution to the consumer. Every operation of this gigantic production line—planting, growing, harvesting, processing and manufacturing—can be coordinated into a more efficient system. We know the hulls must be removed for making peanut butter, but do we know the best place? Presently they are removed by the processor after the peanuts are sold by the farmer. Might our line be more efficient if the hulls were removed in the harvesting operation? No one knows; therefore, we need to concern ourselves with more than one phase or one operation of the total.

RESEARCH POLICIES

There are four policy concepts that we need to think about seriously if we are to meet our goals quickly and effectively.

Policy No. 1: Emphasize Scientific Research

For the purpose of this paper, I should like to distinguish between scientific research and engineering development. Engineering development pertains to designing, modifying, testing and evaluating existing methods and principles. Sometimes these activities are called applied research. Regardless of the name used, it involves resourcefulness in the application of knowledge. It is an essential step from the basic discovery to practical usage.

Scientific research, on the other hand, refers to those activities designed to discover and express mathematically relationships and principles. The word "scientific" refers to the manner in which research is conducted. It is scientific if the causes and effects are known and why. The why of these relationships must be expressed mathematically. Mathematics is a tool of the scientists. The results are reproducible, exact and precise. Some of our applied as well as basic research can be classified in this category.

Some may say that the science of biological processes should be left to the pure scientists and that agricultural engineering should confine its activities strictly to engineering practices. Regardless of whether it is called pure science or not, the fact remains that the mathematical relationships of the physical to the biological processes are basic to developing superior engineering systems. Our profession needs some fundamental law on which to base our judgments and guide our direction and pattern of growth for engineering the biological system. The core of our profession should be built on engineering laws governing the intricate complex processes of plants and animals. This is the thing that distinguishes agricultural engineering from other engineering professions.

From the general world of science and engineering there is an abundant flow of new discoveries that are being translated into practical engineering designs for agriculture. New metals or new wood fabrications for new buildings, plastics for containing silage, fabrics for materials handling, etc. We are woefully lacking, however, in a source of knowledge that is fundamental to improving the performance of the biological factory. The fundamental principles that are needed are physical-biological relationships.

An example might be cited with respect to planting. In the early days the planting of the seed was accomplished by poking a hole in the ground with a stick, dropping in the seed by hand and pressing the soil with one's foot. Over the years fine progress has been made in utilizing unique shapes of iron, rubber and materials to mechanize and automate this operation. However, the principle of the machine remains basically the same. We cannot advance much further in improving the planter and methods, until we understand how seed germination is influenced by the environment.

Considering our inadequacy of understanding the fundamentals of how the biological factory is influenced by the physical, agricultural engineers must devote a major portion of their resources to scientific research in this area. If we don't, the development engineers will have little to work with tomorrow. The agricultural engineer with a working knowledge of mathematics, a depth of understanding of physics, mechanics, thermodynamics, and an appreciation of and vital interest in biological systems, is best equipped and has the greater incentive to do the job. It is a wide-open field into which we should move. The future belongs to those who take advantage of such opportunities.

The policy suggested is that we recognize the importance of both areas — scientific research and development. However, we need to place greater emphasis on scientific research, particularly on physical-biological relationships. This is our major area of weakness.

Policy No. 2: Encourage the Individualists—The Non-Conformists

Our science needs to value the individualist. This is the type of man who does not accept things without applying some inquisitive and inquiring thinking. He is a researcher with impact, for he challenges the

things of today and is dedicated to making present principles obsolete. The responsibility of his job dictates that he be a nonconformist.

We need to adopt the policy of making room for the individualist in our research program. We also need to place more responsibility and authority on this type of researcher and less on a committee approach.

Along with this we must all be prepared to feel uncomfortable, for our personal discoveries and accomplishments will be challenged and will be made obsolete. We must accept the fact that nothing is static—that progress will march forward. We must accept this as the price necessary to meet competition.

Policy No. 3: Coordinate the Educational and Research Programs in Science

The ability of a new generation to do a better job of solving problems depends fundamentally on our educational program. Although there is room for improving the educational program in technology, our weakness lies in the educational program for training agricultural-engineering scientists. To solve the type of scientific problems envisioned in this paper will require men equipped with different thinking tools. Since this paper deals with research, I shall not dwell on the details, but refer readers to other articles describing the bachelor of science through the doctor of philosophy degree programs.

The policy needed is to encourage science education in agricultural engineering for those who desire and are capable of attaining it.

An essential part of this policy lies in improving a partnership of education and research. We can only achieve our goals by being creative and we can only improve the ability of the next generation to create by our educational program of today. The objective of science education is to develop creative individuals; the true objective of research is to be creative—they are complementary. We must incorporate education of the young creative mind into scientific research efforts.

Policy No. 4: Further Interdiscipline Coleadership

If we are to broaden our perspective to encompass the entire system, we must also broaden the philosophy of cooperation among disciplines. Genetics, nutrition, environment-plant relationships, operations, and energy conversions are all closely tied together. It was stated at the outset that we must commercialize agriculture to meet competition. If so, the objectives of geneticists and nutritionists must be projected to meet the needs of this kind of society. This is to say that it is mandatory that the characteristics of the biological plant, as well as its environment, modifications and operations be fitted into the successful engineering systems. This calls for cooperation and coleadership.

The discipline of agricultural engineering is involved in the biological aspects of this system because physical factors are influential. Further, these biological-physical relationships must be expressed mathematically—the tool of the engineer. In addition, instrumentation for scientific observations must be developed and used—an activity the engineer is best able to perform. In the final analysis, the knowledge, the interpretations and ideas developed therefrom must be put into practical application by the design and operation of the equipment fitted into an engineering system—clearly a responsibility of the agricultural engineer. The engineer is indispensable in every aspect of scientific research and development.

The policy recommended is to exert greater initiative in bringing into research projects other disciplines on a coleadership basis.

Conclusion

In conclusion, the challenge of engineering applied to biological systems is first, to gain an understanding of the mechanism and the process of energy conversion in the plant and animal and, second, to commercialize these conversions. We must make the conversions and the operations pertinent thereto, predictable, efficient, powerful, and dependable.

We have at hand a giant, as big and vast as the sun and earth combined, awaiting to be stimulated and developed. For agriculture and agricultural engineering, it carries the tag "Opportunity Unlimited."

. . . Water Surface Disturbances

(Continued from page 192)

face. Wave amplitude was thus deduced from these measurements.

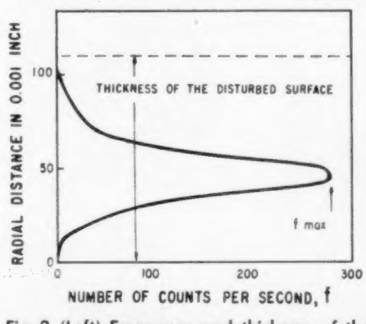
For the wave length measurement, the arrangement of the equipment was changed slightly. The needle was set back to the first point where the peak of the wave was located, and was moved through the same path as in the previous measurement of frequency. The time interval meter then accumulated all of the individual time intervals during which the needle tip was immersed inside the wave. Measurements of the velocity of that part of the jet under observation then permitted calculations of the wave lengths.

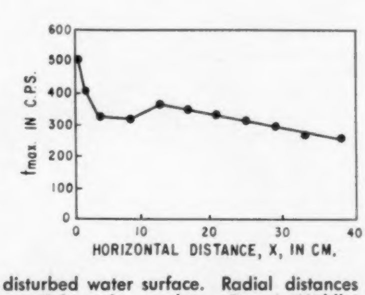
Reproducibility

A good reproducibility could be obtained as long as the motion of the wave repeated itself precisely. In the case where the method was applied to investigate the surface disturbances along the water jet, then the reproducibility depended not only on the precision of the experimental technique but also on the nature of the random motion of the jet. In the latter event, the data from the measurements must be treated statistically.

Typical Results of Measurements

When the needle was set at a given horizontal distance from the nozzle, the thickness of the disturbed surface and the wave frequency at points within the boundary were measured. The measurements shown in Fig. 3 indicate that the wave frequency at points within the boundary followed a slightly skewed normal curve. This tendency persisted at every point along the jet axis until the jet finally broke up into discontinuous drops. Fig. 4 shows the relation of the maximum frequency to horizontal distance from the nozzle. Fig. 5 shows the change in the thickness of the disturbed surface after the jet emerged from the nozzle. Data such as these have thus provided a better understanding of the phenomena of the distintegration of a water jet, which is an important characteristic of most sprinkler irrigation systems.





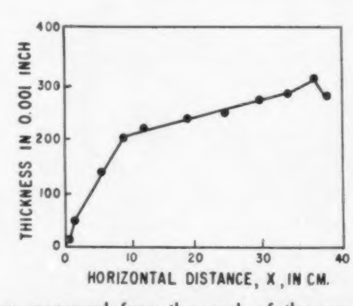


Fig. 3 *(Left)* **Frequency and thickness of the disturbed water surface. Radial distances were measured from the peak of the wave system toward the axis of the jet at a distance** *X* **from the nozzle • Fig. 4** *(Middle)* **Maximum wave frequencies as a function of horizontal distance from the nozzle • Fig. 5** *(Right)* **Thickness of the disturbed surface of the jet as a function of horizontal distance from the nozzle**

. . . Drying Shelled Corn

(Continued from page 187)

moisture moved through the kernel, whether from the heated side upward or from end to end.

Characteristic drying curves of the various parts of the kernel cut up as previously mentioned showed that the drying rates of the H, M, U and T parts of the kernel were unaffected regardless of whether the white or yellow side of the kernel was against the heated plate. With the white side in contact with the heated plate, the white side, which had the highest initial moisture content, had a faster drying rate and dried to a lower moisture content than the yellow side by approximately 5 percent (d.b.). When the drier yellow side was in contact with the heated plate the drying rates of the two sides were almost equal, with the yellow side being the driest at the end of the drying period by about 1 percent.

From the drying curve of the parts of the kernel it can be seen that the moisture moved mainly out of the T section. Fig. 3 shows that at the end of 20 min the H section had dried at a faster rate than the U and M parts and was the driest of all four parts of the kernel. The T part had the lowest moisture content of the four sections after about one hour. The H section was drier than the M and U sections for the first two hours, after which the three portions were at approximately the same moisture content.

Conduction heating for drying single layers of a product could be in the form of an endless belt arrangement with heat applied beneath the belt, on top of the belt, or in the form of electrical resistance in the belt or other means. Another method would be a heated metal plate with a vibrator to move the product across the plate if a continuous system was desired. Inert heated materials could be mixed with the grain to heat it by conduction for drying. Thin layer drying of light products could be quite difficult if convection means were employed with high air flow rates. Conduction means of drying could handle the light as well as the heavy products since the air flow is not large enough to carry the products away.

Conclusions

1 The higher the plate temperature, up to 229 F, the faster the rate of drying.

2 Natural convection was sufficient in conduction drying of one layer to carry away the moisture as rapidly as vaporization occurred.

3 The drying rate by conduction can be defined by the differentiated form of the equation $(M-Me)/(Mo-Me) = e^{-k\theta}$, as is used for convection drying, with a different k value for each falling rate period.

4 The drying rate of the entire kernel was the same regardless of which side of the kernel, white or yellow, was against the heated plate.

5 Drying occurred in four falling rate periods for shelled corn at 56 percent moisture (d.b.), dried to approximately 8 percent (d.b.).

6 The tip of the kernel contained the highest moisture content of any part of the kernel at the beginning of drying and the lowest after drying to below 22 percent (d.b.), when starting with 56 percent moisture content (d.b.) shelled corn.

7 The moisture moved mainly out of the tip of the kernel.

8 Reducing the plate temperature of 229 F by 40 F approximately doubled the time required to dry shelled corn from 56 percent (d.b.) to 15 percent. Likewise, reducing the temperature by 85 F approximately quadrupled the time, and reducing the temperature by 125 F increased the drying time by a factor of 13.

9 Conduction drying was faster than convection drying to dry to normally accepted values for storage. Drying shelled corn by conduction heating from 56 percent moisture content (d.b.) to 15 percent (d.b.) at 229 F, saved 10.2 percent drying time; at 189 F, saved 15.1 percent drying time, and at 144 F saved 16.5 percent drying time.

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ASEE Meeting Details

AGRICULTURAL Engineers will be interested to know that plans are shaping up for an outstanding meeting of the Agricultural Engineering Division, ASEE, at Lexington, Kentucky, following the ASAE Annual Meeting in June. Program Chairman Blaine F. Parker, reports that an excellent program has been arranged for Friday, June 30, and Saturday, July 1. Included in the program on Friday will be a talk on food and agriculture by a top authority of the USDA. Also, in keeping with the theme of "Agricultural Engineering in World Agriculture," there will be a discussion on the subject, "Influence of Attitudes, Cultures, etc., on Engineering Education in Other Countries," by Mr. Malcolm Jones, head, Water Resources and Equipment Branch, International Cooperation Administration, Washington, D.C. There will also be a topic, "Educational Needs of Foreign Students in the United States Classroom," by Dean J. N. Efferson, College of Agriculture, Louisiana State University, Baton Rouge, Louisiana. This will be followed by a talk on "Viewpoints of a Former Student from Abroad," by N. N. Mohsenin, associate professor of agricultural engineering, Pennsylvania State University. "Analysis of Engineering Curricula Evaluations" will be the topic of an address by A. H. Willis, dean of engineering, University of New South Wales, Australia.

In the evening there will be a special chicken barbecue at Spindletop Mansion.

On Saturday, July 1, there will be a "Bluegrass Tour." Included in this will be a visit to Ashland, home of Henry Clay; a visit to several Bluegrass horse farms; and a visit to the home of Mary Todd Lincoln.

ASAE Officers for 1961-62

The following new officers of the American Society of Agricultural Engineers were elected as a result of the regular election conducted by letter ballot of its corporate members. They will take office and B. T. Virtue will automatically advance from president-elect to president at the close of the Society's Annual Meeting to be held on the campus of Iowa State University, Ames, June 25 to 28.

President-Elect — *A. W. Farrall,* head, agricultural engineering department, Michigan State University, East Lansing.

Vice-President—*Howard Matson,* head, engineering and watershed planning unit, Soil Conservation Service, USDA, Fort Worth, Texas.

Councilors — *E. T. Swink,* head, agricultural engineering department, Virginia Polytechnic Institute, Blacksburg (Education and Research Division); *S. S. DeForest,* industrial representative, market development division, United States Steel Corp., Pittsburgh, Pa. (Farm Structures Division); *C. B. Richey,* chief research engineer, Tractor and Implement Division, Ford Motor Co., Birmingham, Mich. (Power and Machinery Division).

Nominating Committee — *J. R. Davis* (chairman), lecturer and associate irrigation engineer, irrigation department, University of California, Davis; *H. T. Barr,* head, agricultural engineering department, Louisiana State University, Baton Rouge; *W. M. Carleton,* assistant director, Agricultural Engineering Research Division, USDA, Beltsville, Md.; *H. J. Hansen,* editor, *Electricity-on-the-Farm Magazine,* New York, N. Y.; *J. B. Liljedahl,* professor, agricultural engineering department, Purdue University, Lafayette, Ind.

In June the new Council of ASAE, consisting of eleven members, will be the first to function after the complete transition of the reorganization of the Council, which began three years ago, to increase the number of Council members from nine to eleven. The Council will consist of one president-elect (A. W. Farrall), one president (B. T. Virtue), one past-president (L. W. Hurlbut), three vice-presidents (E. W. Schroeder, S. M. Henderson, and Howard Matson), and one councilor for each of the five ASAE divisions (C. B. Richey, PM; S. S. DeForest, FS; E. T. Swink, E and R; F. W. Andrew, EPP; and J. R. Carreker, SW). As president-elect, A. W. Farrall will automatically succeed B. T. Virtue as president of ASAE in June 1962.

Members of the Society are invited to send to any member of the Nominating Committee such suggestions as they may have for nominees for election of officers of the Society in the next annual election which will be held early in 1962. It is desirable that such suggestions reach the Nominating Committee on or before June 1, 1961.

Takes Part in Career Day

ASAE member Merritt D. Hill, vice-president and general manager, Tractor and Implement Division, Ford Motor Co., Birmingham, Mich., was featured speaker during Berrien County agriculture career day, held recently, in which six high schools in southwestern Michigan participated. Above, Hill chats with Frank A. Madaski *(left)*, Berrien County extension director, and John P. Chase, farm director at Radio Station WHFB

ASAE Members Approve Membership in CIGR

ASAE members in a letter ballot, which closed on March 27, approved a proposal favoring application by ASAE for "National Association" membership in International Commission of Agricultural Engineering (Commission International du Genie Rural "CIGR"). The proposal appeared on a special ballot in the regular election of Society officers following action by ASAE Council during the Winter Meeting in which it voted to apply for membership in CIGR, subject to ratification by ASAE members. The results were 1575 to 164 in favor of the proposal. Details concerning the scope and purpose of the international organization and what ASAE membership in CIGR means appeared in an editorial, written by L. H. Skromme, past-president of ASAE, in the January issue — page 13.

Details for Annual Meeting Extension Exhibits

Share your ideas with fellow agricultural engineers by participating in the extension exhibits at the 54th Annual Meeting of ASAE to be held June 25 through 28, at Iowa State University. The Committee on Extension, with the assistance of the Meetings Committee at Iowa State, is planning for an outstanding exhibit located in the center of activities in the Iowa Union Building.

The exhibit classes include publication, demonstration models and displays, movies, radio, television, slides, and extension methods or recipes. Blue ribbons will be awarded in all classes. Industry groups will compete separately from public agency displays.

A special letter and entry blank have gone to ASAE members identified in the Society Headquarters as engaged in extension work. Additional entry blanks are available from the Society and from members of the Extension Committee. Following is information on specific classes of exhibits.

Publications: The classifications under this exhibit have been increased to include (1) printed bulletins, (2) circulars, idea sheets, or service letters, (3) newsletters or periodicals, and (4) manuals or leaders' guides. Each ASAE member may enter a publication in any one or in each of the classifications listed. Write for an application blank to W. A. Maley, United States Steel Corp., P.O. Box 464, Des Moines 2, Iowa.

Demonstration models and instructive exhibits are to show developments having engineering applications relating to agriculture, the primary objective of which is the education of the viewer. Classes will be provided for public agency and industrial groups in both portable demonstration models and instructive displays. Information and the forms for entering demonstration models and instructive displays may be obtained from T. L. Willrich, extension agricultural engineer, Iowa State University, Ames, Iowa.

(Continued on page 214)

Stewart Named AE Department Head at Ohio State

Robert E. Stewart has been appointed professor and chairman of the agricultural engineering department at both Ohio State University and the Ohio Agricultural Experiment Station to succeed R. D. Barden, who retired in September of last year. The appointment recently was approved by the respective governing boards of the two institutions and becomes effective July 1.

R. E. Stewart

A native of Carthage, Mo., he was graduated from the University of Missouri in 1948, with a B.S. degree in agricultural engineering. He joined its staff that same year as a research assistant, and received an M.S. degree in 1950 and a Ph.D. degree in 1953 — both in agricultural engineering. Since 1954 he served as professor of agricultural engineering at Missouri, where he has been in charge of teaching and research work in farm structures. From 1941 to 1945, he served as a commissioned officer in the U.S. Army Air Corps. He was successively a flight instructor, flight-test engineering officer, aircraft maintenance officer, and light bomber pilot. He is now a lieutenant colonel in the Air Force Reserve.

His principal researches have been in animal shelter engineering, working closely with research workers in animal physiology, particularly with the late Samuel Brody of Missouri. He has taken a leading part in the psychroenergetic engineering phases of research conducted in the University of Missouri Climatic Laboratory. In 1954 he and Mr. Brody went to Australia to serve as consultants to a governmental research orgaization on the planning and design of a climatic laboratory especially suited to the needs of animal shelter research in that country. One of the results of his studies in animal shelter engineering has been the design and development of a partitional calorimeter for measuring and recording heat given off by animals. The device also measures and records separately those fractions of the total given off by radiation, by evaporation, and by conduction and convection. Recently he received a grant from the National Science Foundation to extend the development.

He has been a member of ASAE since 1948 and is vice-chairman of its Education and Research Division. He is also a member of the Radiation Research Society, Missouri Society of Professional Engineers, National Society of Professional Engineers, American Society for Engineering Education, Sigma Xi, Tau Beta Pi, Gamma Sigma Delta, Gamma Alpha, and American Association for the Advancement of Science, as well as a registered professional engineer in Missouri. He is also listed in "American Men of Science."

CHECK POINTS

by J. L. BUTT

Ants or Grasshoppers

REMEMBER the fable of the ant and the grasshopper — where the ant worked to store up food for the winter while the grasshopper played in the sunshine with no thought of preparing for the future?

At this stage, it appears that the very excellent ASAE career motion picture might become a contemporary parallel to this fable.

In some areas there is tremendous use of the picture resulting in considerable public exposure to the field of agricultural engineering. In these areas, the film is being shown, not only to high school youth, but also to many adult groups where the benefits of this exposure will be far-reaching — opening up job opportunities, paving the way for subsequent agricultural engineering contacts, building up public acceptance and recognition of the importance of agricultural engineering and the work of agricultural engineers.

But in other areas, activity is ominously lacking. The motion picture is gathering dust. Students and adults in these areas still wonder "what is agricultural engineering anyway?" And you can bet that from these areas several years hence — just like the grasshopper — there will be cries of anguish and appeals for help in explaining agricultural engineering to the local public.

For example, the USDA Motion Picture Service reported that our career film had received 303 requests for showings from USDA film libraries throughout the United States through December, 1960 (total audience — 16,364). Dividing this by fifty states, we have an average of about six showings per state. We know that many states have far exceeded the average; therefore, we must conclude that in some states it has hardly been shown at all. What is the situation in your own area?

There are many bright spots. The Motion Picture Service also advises that the agricultural engineering movie was requested for TV showings, through the USDA and film libraries, on 57 occasions. Based on average estimated audience figures, this activity alone probably brought the agricultural engineering story before an audience of 2,850,000. And the ASAE movie was the *second most popular film* offered by the USDA for TV showings during 1960. So our story is popular and well liked — why deny others the privilege of seeing it?

Requests from various states to ASAE for quantities of the *free* promotional literature, which is a part of the five-step plan promotional package, have also been quite varied — from as many as 7000 copies in one state, to *no requests* from other states. We repeat, *this material is free* for use with the movie — paid for by the excess of income over expenses resulting from our successful motion picture project.

As a means of indicating the activity that can be generated by an aggressive promotional effort, may I briefly describe what has been done in the State of Illinois. Originally, three prints of our film were available for use in that State. Increased demand around the first of the year resulted in a request for two additional prints. In March, still additional demand for showings of the film brought still another purchase order for two more prints — bringing the total number of prints now being fully utilized in Illinois to *seven.* At this rate, by the end of 1962 a good percentage of the people in Illinois will be aware of the profession of agricultural engineering—and the climate for agricultural engineering progress (and student interest) will be enhanced.

We wondered how they had been so successful in generating such interest. So we asked Elwood F. "Woodie" Olver, who is coordinating this activity in Illinois, how he went about it. Following is the essence of his reply:

"1. First of all, Dr. Lanham, Head of our Department, writes many letters to every prospect which the staff discovers.

"2. Dr. Lanham sent a letter to every one of the 1200 high school principals throughout Illinois and included the two leaflets which you sent us (the free five-step plan leaflets).

"3. The extension people in agricultural engineering show the film whenever they can during their meetings.

"4. Every agriculture teacher has received a message, along with the two leaflets, as a result of a talk given to the supervisors of Vocational Agriculture at a recent meeting.

"5. Our leaflets are being distributed to high schools during Career Days which are scheduled through the College of Education.

"6. Our agricultural engineers are attempting to participate in as many Career Days as possible.

"7. The theme of the spring meeting of the Central Illinois Section is student recruitment, and we will attempt to bring in top prospects from throughout the State.

"8. Illinois agricultural engineers cooperate by speaking on agricultural engineering at their local high schools, showing the film, and distributing literature.

"9. The film has been shown on television several times in the State.

"10. We are developing short leaders to be added to the film, narrated by Dr. Lanham, which relate the story to our local curriculum and facilities.

"11. The State has been divided into 22 sections and a staff member is in charge of each section. When a request for a film arrives, it is referred to the staff member in charge of that area. The staff member makes sure that a film is available and makes arrangements for a local agricultural engineer or staff member to be present during the showing. We have prepared a presentation which can be given at these showings.

"I guess the best way to summarize the efforts we have made is to say that every member has become vitally interested in recruitment."

We know that at least eight or ten other states have similar programs now functioning, although no others to our knowledge, are making full use of seven prints of the film. But these are *not* the states that concern us; rather it's those areas which are hardly using the film at all, which have requested no literature, and which "play in the sunshine" while the period of the film's greatest potential value slips away. The time for action is *now* — The race has already begun — "Time and (opportunity) wait for no man."

Procedure for Making Program Suggestions

In the interest of keeping the ASAE membership informed as to the proper method to use when submitting a paper for presentation at a national meeting, it has been suggested that a statement appear in the Journal immediately preceding each national meeting listing the appropriate person to contact for each of the ASAE divisions. Suggestions for the 1961 Winter Meeting program will be under consideration during the Annual Meeting in June. Therefore, suggestions should reach the proper individuals in sufficient time to permit the program to be consolidated at this meeting. It is important that a complete copy of each paper or a letter describing the material covered in the paper be submitted with program suggestions. The men responsible for preparing the 1961 Winter Meeting program for their respective divisions are as follows:

Education and Research Division
R. E. Stewart, professor of agricultural engineering, University of Missouri, Columbia, Mo.

Electric Power and Processing Division
K. H. Norris, 11204 Montgomery Road, Beltsville, Md.

Farm Structures Division
F. W. Kesler, Research and Development Department of Farm Products, Rilco Laminated Products, W-891 First National Bank Bldg., St. Paul 1, Minn.

Power and Machinery Division
A. B. Skromme, chief product engineer, John Deere Spreader Works, East Moline, Ill.

Soil and Water Division
Drainage Group — E. W. Gain, 7610 West Chester Pike, Upper Darby, Pa.
Hydrology Group — L. L. Harrold, project supervisor, SWCRD, ARS, USDA, Coshocton, Ohio
Irrigation Group — J. T. Phelan, 1845 Dakota St., Lincoln 2, Nebr.
Soil Erosion Group — B. A. Jones, associate professor, agricultural engineering department, University of Illinois, Urbana, Ill.

Public Lands and Public Works Committee
C. L. Hamilton, Bureau of Docks and Yards, Department of the Navy, Washington 25, D. C.

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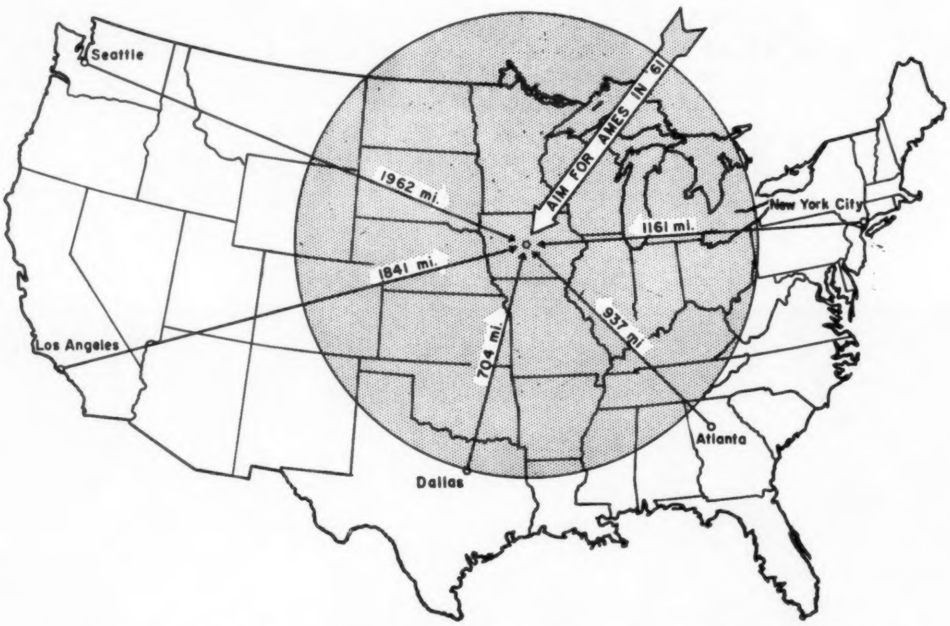


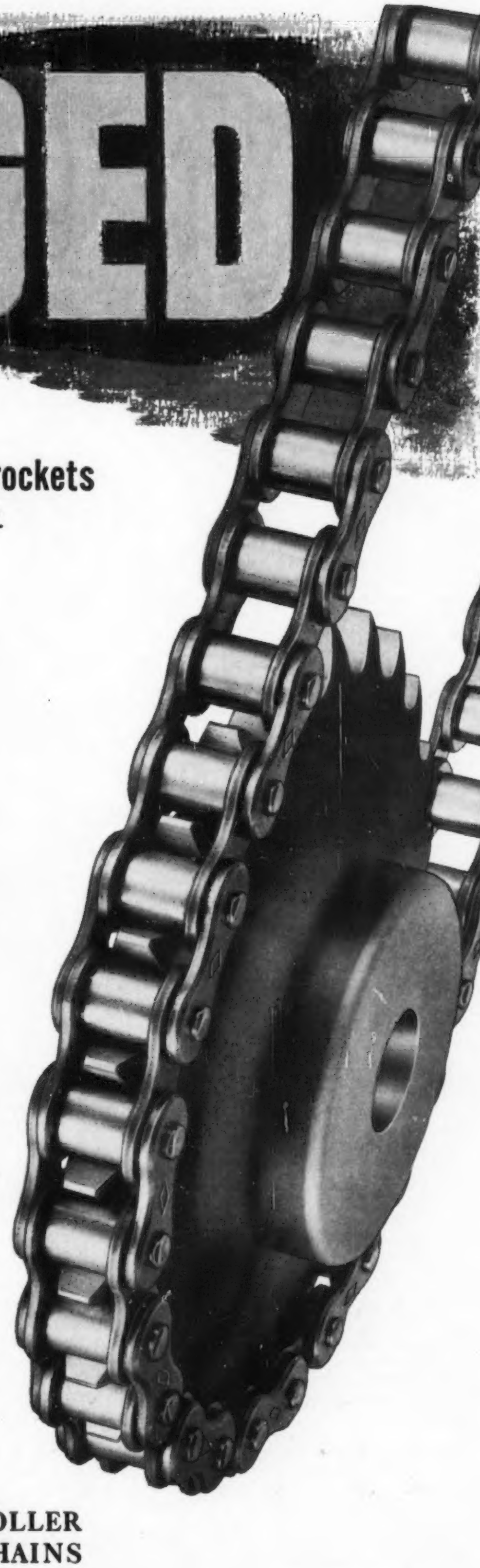
AREA WITHIN CIRCLE REPRESENTS LESS THAN 1½ DAYS DISTANCE BY CAR

NESTLED in the heart of the nation's "breadbasket" and in a state said to possess 25 percent of all the Grade A soil in the world, Iowa State University is already brushing off the welcome mat for the 54th Annual Meeting of the ASAE June 25 to 28. University supporters, basing their claim on the fact that students have traveled to ISU to study agriculture from the Yangtze to the Volga, from the Congo to the Nile, and from the Amazon to the Yukon, have referred to the campus as a "crossroads of the world". Borrowing a page from the same book, members of the local arrangements committee for the coming ASAE Annual Meeting have concluded that for ASAE members Ames also could be considered the "crossroads of the nation". By a little extra research the committee has determined that over one-half of the total ASAE membership lives within an easy 1½-day drive by automobile, and at most, Ames is only a 3-day automobile drive from the farthest city in the United States (excluding Alaska and Hawaii). For those ASAE members planning post-meeting vacations the central location of Ames, it was pointed out, makes it an excellent "jumping-off" spot for a vacation to any part of the country.

In addition to technical sessions, in which over 120 papers will be presented, several interesting tours are being arranged. Thirty miles south of the campus, visitors can tour the John Deere Des Moines Works where equipment such as cotton and corn pickers is manufactured. Another tour will feature a farm where atomic energy is being put to work evaluating the effect of radiation on swine. Another will be an inspection of Iowa State's swine nutrition and environmental research projects. It now appears that engineers will be permitted to tour the $16 million National Animal Disease laboratory which is being completed just northeast of Ames. Late word is that maximum security will probably not be in effect until July 1, so ASAE members should be able to inspect the entire physical plant.

Housing arrangements will be made on a family-non-family basis. Couples with children can stay in one dormitory; couples without children in others; and men who come alone will be housed in yet another dormitory. "Aim for Ames in '61" is the advice being administered freely by those in charge of all details of the coming ASAE Annual Meeting.

RUGGED



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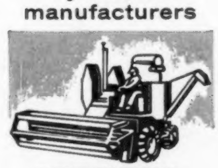
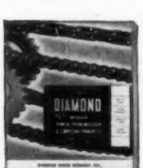


SPECIFIED:
by combine manufacturers

SPECIFIED:
by planter manufacturers



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Raymond I. Birkholz


Benson J. Lamp


R. M. Johnstone


J. A. Savoldi

Raymond I. Birkholz has been appointed to the position of staff engineer for foreign operations, engineering department, International Harvester Co. He has been associated with IH since 1935 and prior to his recent appointment was staff assistant, product engineering, at its Farm Equipment Research and Engineering Center, Hinsdale, Ill.

Benson J. Lamp, formerly associate professor of agricultural engineering at Ohio State University and Ohio Agricultural Experiment Station, recently has joined Massey-Ferguson, Inc. in Detroit, Mich. In his new position as agricultural research engineer on the staff of the vice-president of engineering, he will search for agricultural research developments and results which may directly or indirectly influence future agricultural mechanization requirements.

R. M. Johnstone, service manager of Oliver Corporation's South Bend (Ind.) plant, has been advanced to special product development work in its engineering department. He has been with the company's farm tillage implement plant for nine years, starting in design and field testing and then becoming service manager.

John A. Savoldi has been promoted to plant manager of the Farm and Home Supplies Plant of United Cooperatives, Inc., in Alliance, Ohio. He formerly held the position of assistant development engineer.

James W. Martin, head, agricultural engineering department, University of Idaho, was elected to the position of vice-president of the Idaho Society of Professional Engineers at its recent annual meeting.

Charles H. Sortor, a consulting engineer, has opened his own office in Fresno, Calif, offering all types of engineering, with special emphasis on service to agriculture. For the past 17 years, he has been employed by Laval Underground Surveys and Peerless Pump, both subsidiaries of Food Machinery & Chemical Corp.

Donald E. Lippke, formerly chief engineer, Knipco Div., Master Vibrator Co., recently has accepted the position of chief dairy engineer with Perfection Manufacturing Corp., a subsidiary of Sta-Rite Production Inc., Delavan, Wis.

J. Frank Bice recently has accepted a position of project engineer with the Farm Equipment Research and Engineering Center, International Harvester Co., Hinsdale, Ill. He formerly was associated with J. I. Case Co. in Burlington, Iowa, as a design engineer.

William R. Bower, formerly plant manager for United Cooperatives, Inc., Alliance, Ohio, now holds the position of product manager with John Wood Co. of Royersford, Pa.

George V. Frushour recently has accepted a position of product engineer with New Idea Division of Avco Corp. in Coldwater, Ohio. His previous position was that of product engineer in charge of all corn harvesting machinery for J. I. Case Co. at Bettendorf, Iowa.

Clyde E. Houston is now associated with the Water Resources and Irrigation Branch of the Food and Agriculture Organization of the United Nations and is located in Rome, Italy. He formerly was extension irrigation and drainage engineer at the University of California.

Albert J. Swearingen has joined the University of Tennessee staff as associate agricultural engineer. Previously, he was a member of the agricultural engineering extension staff at Pennsylvania State University.

Albert H. Miller, formerly manager of Albar Building Sales, has accepted the position of manager of Butler Building and Tank Division, Harry D. Kantor & Son Construction Co., in Clarksdale, Miss.

Robert L. Nichols, formerly western editor of *Farm and Ranch* magazine, recently has been appointed editor of the southwest edition of *Electricity on the Farm* magazine. He joined The Reuben H. Donnelley Corp. in 1953 as associate editor of the *Farm and Ranch* magazine, and over the past several years has also held the positions of managing editor and Washington editor.

Neil F. Bogner has been promoted to the position of construction management engineer at the Milwaukee, Wis., Engineering and Watershed Planning Unit of the USDA Soil Conservation Service. He was transferred from Macomb, Ill., where he served as project and area engineer.

David K. Bowen has assumed the position of party leader for the Arkansas Watershed Work Plan Party of the USDA Soil Conservation Service. He will be headquartered in Little Rock, Ark., and will serve the entire state in planning watershed protection and flood prevention projects. He previously was work unit conservationist with the SCS.

William C. Eaton has assumed the position of chief product engineer for the Owosso Division, Midland Ross Corp., Owosso, Mich. He joined the company in 1957 as a design engineer, having previously been employed by the Tractor and Implement Division, Ford Motor Co., Birmingham, Mich.

Orlean R. Moe, formerly assistant agricultural engineer, technical department, Hawaiian Commercial and Sugar Co., Ltd., has accepted the position of industrial engineer with the Kehaha Sugar Co., Ltd., on the island of Kauai. In his new position he is in charge of the company's industrial engineering program, and is primarily concerned with methods improvement, wage incentives, and cost control. His work will cover most phases of plantation operations, including cultivation, planting, irrigation, and harvesting.

James R. Hammerle is now located in Kisarin, Sumatra, Indonesia, where he is supervisor of mechanical replanting for the United States Rubber Co. Formerly, he was territory sales supervisor for J. I. Case Co., Lancaster, Pa.

Lewis G. Campbell has accepted a position on the University College of the West Indies staff at St. Augustine, Trinidad, West Indies, as a lecturer in agricultural engineering. Previously he was associated with the Trinidad Department of Agriculture as an agricultural engineer. In his new position, he is responsible for lecturing in agricultural engineering subjects which are included in the course for the B.S. degree (agriculture) of London University. He also handles a course in soil and water conservation for postgraduate students in general tropical agriculture.

J. G. Andros has joined Rink Building Systems, Inc., Baltimore, Md., in the capacity of sales manager. He formerly was steel building representative for Butler Manufacturing Co.

Robert M. Carter, III, advises that he is now employed by the Hamilton Standard Division, United Aircraft Corp., at Windsor Locks, Conn. He previously was a tire engineer with Goodyear Tire and Rubber Co.

Allen F. Butchbaker is employed as a half-time instructor in the agricultural engineering department at the University of Missouri, where he is also working on a Ph.D. degree in agricultural engineering in the area of farm structures. He previously was a research assistant in the agricultural engineering department at Michigan State University.

Harold A. Kramer, agricultural engineer (research), Market Quality Research Division, USDA, Beltsville, Md., recently was awarded a Certificate of Merit in recognition of his research work at Beltsville. He was presented this certificate for his exceptional technical competence and resourcefulness in developing automatic equipment for sampling and grading peanuts which contributes importantly to the speed, accuracy and economy of the operation and to the more orderly marketing of the crop. Along with the certificate, was granted a cash award of $250 for his contribution to the efficiency and economy of operations.

Marvin E. Heft, formerly farm service advisor, Consumers Power Co., Grand Rapids, Mich., has accepted the position of extension agricultural engineer, with the University of Connecticut. His main duties are in the field of materials handling and farm structures.

EVENTS CALENDAR

April 15-25 — *1961 Swiss Industries Fair*, Basle, Switzerland. Details may be obtained from Consulate General of Switzerland, 75 E. Wacker Dr., Chicago 1, Ill.

April 17-19 — Eighth *National Watershed Congress*, Ramada Inn, Tucson, Ariz. Details may be obtained from The National Association of Soil Conservation Districts, League City, Texas.

April 17-21 — *American Welding Society 42nd Annual Convention*, Commodore Hotel, 42nd St., New York, N. Y. For further details write to Information Center, AWS, 33 W. 39th St., New York 18, N. Y.

April 18-20 — *North Central Regional Extension Agricultural Engineers' Workshop*, Del Prado Hotel, Chicago, Ill. For information write to Arthur H. Schulz, Extension Service, North Dakota University, Fargo, N. D.

April 20-22 — *76th Annual Convention of the Illinois Society of Professional Engineers*, Peoria, Ill. Information may be obtained from ISPE, 1108 East London Ave., Peoria, Ill.

April 22 — *27th Annual Meeting Michigan Section, American Society for Engineering Education*, Kellogg Center, Michigan State University, East Lansing. For information write to ASEE, Continuing Education Service, MSU, East Lansing, Mich.

May 1-2 — *The American Zinc Institute Annual Meeting*, Drake Hotel, Chicago, Ill. Details may be obtained from AZI, 324 Ferry St., Lafayette, Ind.

May 2-4 — *Purdue Industrial Waste Conference*, Purdue Memorial Center, Purdue University, Lafayette, Ind. Further details may be obtained from D. E. Bloodgood, conference chairman, Purdue University, Lafayette, Ind.

May 7-10 — *American Feed Manufacturers Convention* and *National Feed Industry Show*, Conrad Hilton Hotel, Chicago, Ill. Particulars may be obtained by writing to E. H. Roesler, editor and publisher, The Feed Bag, 1712 W. St. Paul Ave., Milwaukee 3, Wis.

May 8-10 — *1961 Spring Lubrication Symposium*, Deauville Hotel, Miami Beach, Fla. For information write to: The American Society of Mechanical Engineers, 29 W. 39th St., New York 18, N. Y.

May 8-11 — *1961 Hydraulics Conference*, Queen Elizabeth Hotel, Montreal, Canada. Information may be obtained from the Engineering Institute of Canada, 2050 Mansfield St., Montreal 2, Canada.

May 9-12 — *1961 Production Engineering Conference and National Industrial Production Show*, The Royal York Hotel, Toronto, Canada. Details are available from The American Society of Mechanical Engineers, 29 W. 39th St., New York 18, N. Y.

May 22-25 — *Design Engineering Show*, Cobo Hall, Detroit, Mich. Information may be obtained from: Clapp and Poliak, Inc., 341 Madison Ave., New York 17, N. Y.

June — *First International Conference on the Mechanics of Soil-Vehicle Systems*, Turin, Italy. For further information write to: M. G. Bekker, national secretary for the Conference, U.S. Army Ordnance Tank-Automotive Command, 1501 Beard, Detroit 9, Mich.

June 9-17 — *European Congress of Chemical Engineering and ACHEMA Congress*, Frankfurt am Main. Information is available from DECHEMA, Frankfurt am Main 7, Postfach.

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WISCONSIN
is as **rugged**
as its 30-hp
big brother!

RUGGED 7-HP "BABY" BKN keeps the compact tractor working like a "Beaver" all year long. Unit mounts various mowers, harrows, plows, scarifiers, tillers, cultivators, snow and grader blades, and other seasonal attachments.

HUSKY 30-HP VH4D propels and powers this high-clearance sprayer and defoliator. The Wisconsin drives the unit easily through sandy soil or sticky loam, and works dependably in extremely high heat.

Rugged dependability runs in the Wisconsin Engine family. That's why the 7-hp "baby" BKN is just as durable on grueling jobs as the 30-hp VH4D. This fact is demonstrated by the year-around tractor and the self-propelled high-clearance sprayer shown. Both applications help you separate heavy-duty engines — *Wisconsins* — from the bargain types.

Wisconsins vary in size and weight, but not in quality or stamina. All have thrust-absorbing tapered roller main bearings, forged-steel crankshafts, and stall-preventing high torque. And all are precision-built to minimize wear and care.

The VH4D brings out the benefits of air cooling. It is smaller and much lighter than a water-cooled equal, thus making the equipment it powers lighter and more maneuverable. Air cooling also slashes servicing and upkeep. And Stellite exhaust valves and seats plus rotators *extend valve life up to 500%!*

Protect your equipment — power it with heavy-duty air-cooled Wisconsin Engines, 3 to 56 hp. We'll tailor the engine for you to cut your assembling time and costs. Send for Engine Bulletin S-249. Write to Dept. O-41.

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MILWAUKEE 46, WISCONSIN
World's Largest Builders of Heavy-Duty Air-Cooled Engines
O-318

Minnesota Section

The Minnesota Section held a meeting on March 16 in the Solarium of the Curtis Hotel in Minneapolis, Minn. The program, an evening schedule, included the showing of a film entitled "Beyond the Graphisphere," which gave the viewers a look into the problems concerned with food for space travel. Also included on the program were talks on the "Minnesota Water Atlas" and on the application of hydraulics to agricultural equipment.

Central Illinois Section

On February 23 the Central Illinois Section held a joint dinner meeting with the Peoria Engineering Council, who sponsored a National Engineers' Week program. This event was held in the Grand Ballroom of the Pere Marquette Hotel in Peoria, Ill. The featured speaker was John W. Massey, a civilian member of the George C. Marshall Space Center staff at Huntsville, Ala. Mr. Massey spoke on space flight.

Baton Rouge Section

The Baton Rouge Section has elected the following officers for the year 1961: F. T. Wratten, chairman; W. F. Lytle, vice-chairman; and L. F. Curtis, secretary-treasurer.

Quad City Section

The Quad City Section held a meeting on March 3 at the American Legion Hall, Moline, Ill. The program included the presentation of a paper on field wafer machine by Dale O. Hull, USDA Extension Service, Iowa State University, and Vernon Lundell, Lundell Mfg. Co., Cherokee, Iowa, and one on row cultivating with manual and automatic steering by Donnell Hunt, agricultural engineering department, University of Illinois.

Washington, D.C.-Maryland Section

The Washington, D.C.- Maryland Section held its February meeting on the 10th in the USDA South Building, Washington, D.C. There were 30 in attendance, including four guests — three of whom were agricultural engineers from Fort Detrick, Md., attending for the first time. R. G. Yeck, chief, Livestock Engineering and Farm Structures Research Branch, AERD, USDA, gave an interesting and informative slide presentation on farm buildings and related facilities in Great Britain and the Scandinavian countries. As a delegate to the second International Bioclimatological Congress of the International Society of Bioclimatology and Biometeorology, Mr. Yeck spent two weeks in England, Scotland, and Denmark.

Included among the slides were views showing old stone farmstead buildings abutting directly on modern paved highways; U-shaped farmsteads with family and animal housing buildings continuous; typical beautification of yard areas with multicolored flowers; "bed-and-breakfast" type covered horizontal silos; Scottish countryside resembling the state of Wisconsin; heather in bloom in Scottish Highlands; picturesque architecture of centuries-old buildings; multi-flued chimneys serving houses heated with individual room fireplaces; patchwork arrangement of small fields surrounding small farm villages housing workers; as well as points of historic interest and of buildings associated with the Royal family.

The March meeting was held on the 10th in the USDA South Building also. The attendance totaled 44, including 10 guests. Among the guests were representatives of the embassies of Austria, Czechoslovakia, and Portugal, and of the Forest Products Research Division of the U.S. Forest Service. Francis A. Scofield, director, Scientific Section, National Paint, Varnish and Lacquer Association, gave a very interesting and informative talk on the composition of the paint industry and on characteristics of the modern paints. He pointed out that the various manufacturers of paints range in size from a one-man organization to a 500-employee organization. Among the types discussed were: Water thinned, acrylic, Latex, epoxy resins, urethane, reflective, fluorescent, fire retardant, germicidal, and mildew-retardant paints.

Henry Edmunds, agricultural attache, British Embassy, will be the featured speaker at the April 14 meeting, which also will be held in the USDA South Building. His subject will be "Impressions of American Agriculture as Viewed Through British Eyes."

North Carolina Section

The North Carolina Section held its winter meeting on March 10 at the North Carolina State College Agricultural Engineering Building. High lights of the technical program included addresses by John O'Meara, USDI Office of Saline Water, Washington, D. C., who spoke on the conversion of salt water into potable water, and Donald M. Seltzer, patent attorney, Charlotte, N. C., who spoke on the development of inventions and protection of them through proper patent procedures. Three papers were presented by staff members of the North Carolina State College agricultural engineering department. These included presentations by Henry D. Bowen, who discussed the unique function of the agricultural engineering profession; another by John W. Weaver, Jr. and George B. Blum, Jr. on the direct loading of forages for wilted silage or wagon dried hay; and a third one by William E. Splinter and Francis J. Hassler entitled "Prospects for Improvements in Tobacco Harvesting and Curing." The following officers were elected to serve for the 1961-62 season: J. F. Kelly, president and general manager, Aeroglide Corp. (chairman); J. W. Glover, extension specialist, Agricultural Extension Service, North Carolina State College (first vice-chairman); T. G. Miller, field representative, North Carolina Rural Electrification Authority (second vice-chairman); and J. F. Beeman, North Carolina State College (secretary-treasurer).

Pennsylvania Section

The Pennsylvania Section will hold a dinner meeting on April 28 at the Dutch Town and Country Inn, Route 30, Lancaster, Pa. The meeting time is set for 7:00 p.m.

Southwest Section

The Southwest Section will hold its annual meeting April 14 and 15 at the Grim Hotel in Texarkana, Texas. The technical sessions will open on Friday morning, April 14, with a Soil and Water program, the theme of which will be "Land Forming for Irrigation and Drainage." Discussions will be presented on land leveling with small equipment in Arkansas; on electronic computers and least-cost land forming; on a comparison of level and graded terraces in the southern high plains; on artificial recharge of ground water by a multiple purpose well; on climatic control chamber for determining transpirational water losses by plants; and on leveling rice lands in water. During the Electric Power and Farm Machinery program scheduled for Friday afternoon, papers to be presented in line with the theme "Electricity and Machines — Tools for Efficient Farming" will be on the subjects of: Linear programming for determining machinery needs; pelleting of feeds in Louisiana; bottom defoliation and harvesting of bottom defoliated cotton; mechanical aids to strawberry harvesting; automation of dairying on the Pacific coast; cottonseed rupture from static energy and impact velocity; the use of electrical heat in greenhouse operations; and automation for the poultry producer. A student program will also be included on the Friday afternoon agenda.

The Friday evening activities will feature the annual banquet at which Chester Lauck of Continental Oil Co., Houston, Texas, will speak. He will be remembered as Lum of the popular Lum and Abner radio show. Entertainment at the banquet will be furnished by Carol Ann Holland, outstanding 4-H talent winner, of Huntsville, Ark.

The theme for the Farm Structures program on Saturday morning will be "Structures for Farm Automation." To carry out this theme the subjects to be discussed will be: Performance of cross-flow systems for drying grain in terminal storages; an experimental environmental controlled poultry house; simplified end attachments for stress-skin panels; and artificial drying and mechanical feeding of chopped hay. The two-day meeting will conclude with a general session on Saturday morning, following the Farm Structures program.

ASAE MEETINGS CALENDAR

April 14—WASHINGTON, D.C. - MARYLAND SECTION, USDA South Bldg., Washington, D.C.

April 14-15 — ROCKY MOUNTAIN SECTION, University of Wyoming, Laramie.

April 14-15 — SOUTHWEST SECTION, Grim Hotel, Texarkana, Texas.

April 20-21 — ALABAMA SECTION, Collins Hotel, Jasper, Ala.

April 24 — BATON ROUGE SECTION, Agricultural Engineering Auditorium, Louisiana State University, Baton Rouge.

April 28 — PENNSYLVANIA SECTION, Dutch Town and Country Inn, Route 30, Lancaster, Pa.

April 28-29 — OHIO SECTION, Secor Hotel, Toledo, Ohio

May 6 — CENTRAL ILLINOIS SECTION, University of Illinois, Urbana, Ill.

May 8 — MINNESOTA SECTION, Prom Center, St. Paul, Minn.

May 12 — MICHIGAN SECTION, Holiday Inn, Jackson, Mich.

May 18-20 — FLORIDA SECTION, Daytona Plaza Hotel, Daytona Beach, Fla.

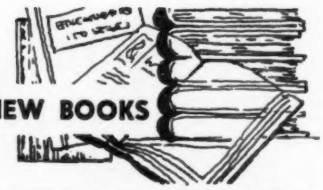
June 25-28—ANNUAL MEETING, Iowa State University, Ames, Ia.

August 20-23—NORTH ATLANTIC SECTION, University of New Brunswick, Fredericton, N. B., Canada.

October 18-20 — PACIFIC NORTHWEST SECTION, Boise Hotel, Boise, Idaho.

December 12-15 — WINTER MEETING, Palmer House, Chicago, Ill.

NOTE: Information on the above meetings, including copies of programs, etc., will be sent on request to ASAE, St. Joseph, Mich.



Agricultural Engineers' Handbook—First Edition, 1961, by C. B. Richey (editor-in-chief), Paul Jacobson, and Carl W. Hall. Cloth. 6 x 9½ in. xi+880 pages. Illustrated and indexed. Published by McGraw Hill Book Co., Inc., 330 W. 42nd St., New York 36, N. Y. $19.50.

This book is in every sense a handbook, the first of its kind to be compiled by and published especially for agricultural engineers in all branches of their profession. Material for the book was compiled by 41 specialists, all recognized authorities in their fields. The material has been carefully selected to make the book of practical, lasting value. The subject matter has been well edited to provide consciseness, clarity and the analytical approach throughout. It is a simple, compact reference book of important fundamentals, for which both students and practicing engineers will find constant use. *Section 1* — Crop Production Equipment — deals primarily with tractors and field machines. Space did not permit covering basic tractor components, which are similar to those used in other automotive vehicles, but several chapters are devoted to such tractor problems as traction, force reactions, fuels and implement controls. In sections devoted to a class of implements, basic components are analyzed and then combined into the various models within the class. *Section 2* — Soil and Water Conservation — is primarily the work of specialists of the USDA Soil Conservation Service and Agricultural Research Service who personally engaged in research or application work. Much of this material has not previously been available to the public. *Section 3* — Farmstead Structures and Equipment — covers areas usually classified as farm structures, rural electrification, and crop processing — or "farmstead mechanization," the integration of crop processing and storage and feed handling. *Section 4* — Basic Agricultural Data — is designed to present concisely agricultural data affecting the solutions of various agricultural engineering problems.

Modern Insecticides and World Food Production, by F. A. Gunther, and L. R. Jeppson. Cloth. 5¾ x 9 in. xv + 284 pages. Illustrated and indexed. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. $8.50.

According to the authors, this book is not written for the specialists in the fields of economic entomology and the chemistry of insecticides, but is designed to provide a general and comprehensive insight into the whys and wherefores of modern insecticides and acaricides — the problems of and arising from their use. The authors point out that sufficient details, examples, and interpretations are included to encourage the reader to develop his own opinions about these necessary but often poisonous substances. The encouragement of real interest, tolerance, and understanding of this situation is the objective of this work, according to the authors.

Off-the-Road Locomotion, by M. G. Bekker. Cloth. 6 x 9 in. xi+220 pages. Illustrated and indexed. Published by The University of Michigan Press, Ann Arbor, Mich. $10.00.

(Continued on page 214)

***Engineering** makes it possible...*

This all-concrete machine shed was such a success, the owner built four more buildings like it.

concrete shell roofs bring a new look to modern farms

Today's big farm news is concrete—and the new ways farmers are using it to achieve real economy in farm structures.

Behind their achievements is the engineer—and engineering advances that are making concrete a popular, *low-cost* building material.

Concrete shell roofs, for example, now easily span 50, 60, even 100 feet without interior supports—and do it with shell thickness as little as 3 inches.

Thus, economy of construction makes all-concrete farm structures truly practical. Progressive farmers can now take full advantage of concrete's lifelong benefits. Little or no upkeep. Fire safety. Ease of cleaning for better sanitation, healthy stock, lighter chores.

Your engineering knowledge plays a vital part in modern farm planning. To help you keep the farmer informed on latest developments, write for free literature about new shapes with concrete. Distributed only in U.S. and Canada.

And watch for more of these reports on news-making concrete farm structures.

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A national organization to improve and extend the uses of concrete

THE MARK OF A MODERN FARM
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MANUFACTURERS' LITERATURE

Literature listed below may be obtained by writing the manufacturer.

Flat-Belt Pulley Bulletin

T. B. Wood's Sons Co., Chambersburg, Pa. — A 4-page, 2-color bulletin, No. 22103, describes and illustrates flat belt pulleys with tapered interchangeable bushings. Also included are dimension charts and price lists.

Screw Conveyor Engineering Guide

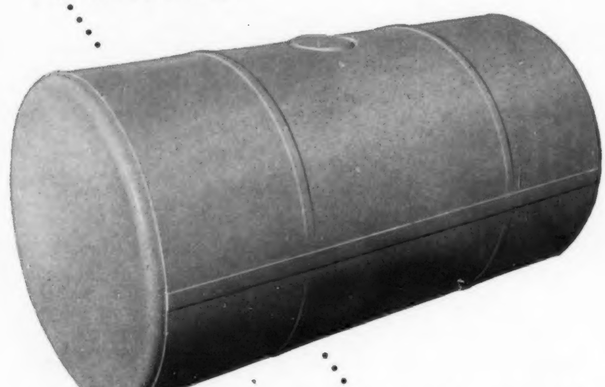
Thomas Conveyor Co., Dept. 216, P.O. Box 11127, Fort Worth, Texas — A 150-page screw conveyor engineering guide contains typical installations of screw conveyors, as well as charts and illustrations on engineering, components, and layouts. Also included is an additional products listing, a part number index and a general index.

Universal Joints

Mechanics Universal Joint Division, Borg-Warner Corp., 2020 Harrison Ave., Rockford, Ill. — A 120-page automotive and industrial universal joint catalog, No. J-1960, complements catalog No. J-1960-1, covering product application in the agricultural and implement fields. Included in No. J-1960 is general engineering data concerning universal joints, as well as descriptive information and joint specifications of the different sizes, servicing instructions, and ordering information.

This tank offers you all three . . .

1. Resistance to chemicals and weathering
2. Durability, impact resistance
3. Low cost



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MOLDED·FIBER GLASS

Terrific for a variety of farm uses, this 200 gallon MFG tank will outlast metal many times over. Won't rust, corrode or deteriorate even in severe weather and exposure. Costs considerably less than stainless steel.

Lightweight, sturdy and strong, it's translucent so you can see level of contents inside. Easy to handle and easy to clean. It's available for immediate delivery, either assembled or knocked-down.

Unaffected by most insecticides, chemicals and liquid fertilizers, liquid or dry, this MFG tank is ideal as a spray tank, portable water tank or storage tank.

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Auger Systems

LML Engineering & Mfg. Corp., Columbia City, Ind. — A 12-page brochure on auger systems for grain and feed handling defines and illustrates installation techniques, assembly parts and costs, and horsepower requirements, as well as mechanical factors. Price, 20 cents.

Liquid Fertilizer Equipment

United States Steel Corp., 525 William Penn Place, Pittsburgh 30, Pa. — Offers the following two literature pieces: An 8-page reprint of article entitled "Corrosion in Liquid-Fertilizer Equipment" from Solutions Magazine; and a 12-page, 4-color, illustrated brochure entitled "Stainless Steel Tanks for All Farm Chemicals."

Transducer Switch

Tann Controls Co., Division of Tann Corp., 3750 E. Outer Drive, Detroit 34, Mich. — A catalog sheet describes and illustrates the microsensitive-transducer proximity limit switch, including a diagram and applications.

Ball Bearings

SKF Industries, Inc., Front St. and Erie Ave., Philadelphia 32, Pa. — Booklet describes and illustrates how Atlas balls are manufactured. One section includes descriptions of Atlas balls from 1/32 in. to 2 5/8 in. diameter and special products, as well as one on methods of measuring and testing balls. Another section shows brass and steel hardness conversion tables, and others cover definitions involved in ball manufacture, and how to order and interpret box markings and also describes the color code adopted to identify balls of different materials in the stockroom.

Dry Lubricating Stick

The Alpha-Molykote Corp., 65 Harvard Ave., Stamford, Conn. — A 2-page, 2-color bulletin (No. 128) gives data on solid-film dry lubricating stick. Included are instructions for the most effective use of grinding wheels and cutting tools. Other applications that are described include tools for cutting other materials, such as paper and wood, and, when machined to shape, as an actual self-lubricating bearing element in small machines.

Combine Catalog

Allis-Chalmers Manufacturing Co., Farm Equipment Division, Box 512, Milwaukee 1, Wis. — A 22-page, 4-color catalog, No. TL-2328 tells the story of the Gleaner-Baldwin combine line. A special feature is the gate-fold page in the center of the catalog, showing a 4-color sectional view of the Gleaner combine to illustrate the inside story of the combine from reel to straw spreader.

Farm Implements for Caterpillar Tractors

Caterpillar Tractor Co., Advertising Division, Peoria, Ill. — A 6-page booklet (Form No. 34001) entitled "Farm Implements for Caterpillar Diesel Tractors," describes and illustrates tool bar implements for tillage and cultivation, deep tillage, and earth-moving and land clearing for use on models D4 and D6 tractors.

Power Transmission Equipment

Browning Manufacturing Co., Maysville, Ky. — Commemorating 75th anniversary is Catalog No. GC-101-F, a 24-page piece describing and illustrating complete line of power transmission equipment, including variable speed belts, poly-V belts and gear belts, as well as roller chain and sprockets. Also included are descriptions and a listing of available stock parts.

The following bulletins have been released recently. Copies may be obtained by writing to author or institution listed with each.

The following two bulletins may be obtained from The Ohio Water Commission, 1562 W. First Ave., Columbus 12, Ohio:

The Problem: Floods in Ohio;

Water Policy and Legislative Recommendations, 1960.

Open Hay Storage Building — Plan No. 5879. USDA Miscellaneous Publication No. 834. January 1961. Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C. Price, 5 cents.

36th Annual Report of the Kansas Committee on the Relation of Electricity to Agriculture. 1960. Agricultural Engineering Department, Kansas State University, Manhattan.

The following bulletins are available from the Cooperative Extension Service, Department of Agricultural Engineering, Michigan State University, East Lansing:

Insulation for Farm Buildings, by Edward Kazarian, James Boyd, and Robert Maddex. Farm Building Circular 741, November 1960.

Milking Parlor Plans for Small Herds, by Donald L. Murray and James S. Boyd. Farm Building Series, Circular 742, January 1961.

Agricultural Drought and Excess Soil Moisture in Eastern North Dakota and South Dakota, by F. D. Whisler. Production Research Report No. 44, January 1961. Eastern Soil and Water Management Research Branch, SWCRD, ARS, USDA, Beltsville, Md.

Petrographic and Engineering Properties of Loess, by H. J. Gibbs and W. Y. Holland. Engineering Monographs No. 28, November 1960. Office of the assistant commissioner and chief engineer, Attention Code 841, Bureau of Reclamation, Building 53, Denver Federal Center, Denver 25, Colo. Price, $1.00.

Grassland-Livestock Handbook, Ninth Revised Edition. 1960. American Grassland Council, Box 30, Norwich, N. Y.

Factors Affecting the Transportation of North Dakota Grain, by Fred R. Taylor and David C. Nelson. Bulletin No. 430, December 1960. Department of Agricultural Economics, North Dakota Agricultural Experiment Station, North Dakota State University, Fargo.

Performance of Auger Conveyors for Farm Feed Materials at Restricted Delivery Rates, by F. L. Herum. Bulletin 666, December 1960. Agricultural Experiment Station, University of Illinois, Urbana.

Professional Income of Engineers — 1960. An EJC report. Engineering Manpower Commission, 29 W. 39th St., New York 18, N. Y. Price, $3.00.

The Application of Drainage in the Reclamation of Salinized Soils. English translation of report published by the USSR Academy of Sciences, Moscow, 1958. OTS No. 60-51191. Office of Technical Services, Business and Defense Services Administration, United States Department of Commerce, Washington 25, D. C.

Positive Temperature Control Reliability...

High sensitivity and positive reliability are important factors in temperature controlled agricultural applications. You get *both* — plus maximum durability — by specifying a Fenwal THERMOSWITCH Unit!

A Fenwal THERMOSWITCH® Unit responds to only 0.1°F temperature change . . . its heat-sensitive outer shell responds *instantly* to a change in temperature . . . *and all contacts are enclosed and protected!*

Fenwal THERMOSWITCH Units cover a range from −100 to 1500°F. They're easily adjustable . . . available as miniature, surface-mounted or immersion types. Special variations to resist corrosion, extreme vibration and shock are also available. All units are simple to install, rugged, compact *and surprisingly low in cost!*

Insure precision and absolute reliability in your own engineering design by specifying a Fenwal THERMOSWITCH Unit. Write today for illustrated booklet. FENWAL INCORPORATED, 274 Pleasant Street, Ashland, Mass.

Another example of how

Fenwal CONTROLS TEMPERATURE... PRECISELY

New Multi-Bearing Takeup Frames

Link-Belt Co., Prudential Plaza, Chicago 1, Ill., has announced new multi-bearing takeup frames, available from stock in 11

sizes and designed to accommodate babbitted, bronze, ball or roller bearings in any two-bolt pillow block with mounting holes up to ⅝ in.

The new frames allow horizontal bearing adjustments from 6 to 24 in. and reportedly will mount 143 different bearing shaft sizes from ⅜ to 2⁷⁄₁₆ in. diameter. Mounting pads are adjusted to the mounting holes in the pillow block. One pad is moved by an adjusting screw, while the other pad slides freely to the proper distance between the pillow block mounting holes. This mounting flexibility permits each size of takeup frame to accept a wide range of pillow block bore sizes. Mounting bolts are zinc-plated and washers and nuts for mounting the pillow block are furnished with each frame.

Introduces Two New Balers

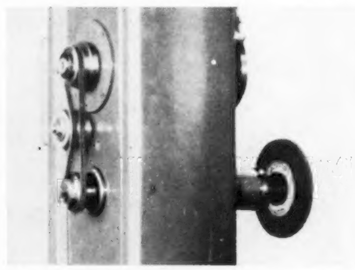
New Holland Machine Co., New Holland, Pa., has introduced two new balers to its line. For haymakers interested in ran-

dom, automatic handling of small bales, the Compact Hayliner 65 *(top photo)* was introduced to make 12 by 16-in. bales in any length from 14 to 48 in. A new feeding system, described as Tele-Flow, was developed. A telescoping feeder bar carries measured amounts of material into the bale chamber, thereby maintaining uniform bale density in light or heavy crops. The model is available as a tractor-drive, twine-tie model.

A new model, designed especially for custom and commercial baling operations, is the Super Hayliner 99, *(bottom photo)* a three-wire model built to bale up to 20 tons an hour. New tandem wire magazines were designed to make field stops for splicing unnecessary and to save wire by preventing tangles. The feeding system also uses a telescoping tine bar to move measured amounts of hay into the bale chamber. Also included is a booster arrangement that helps prevent clogging and jamming by moving hay faster into the path of the feeding system tines. The pickup is a wide 56 in., plus a 5½-in. flare. Six tine bars, each mounted on sealed ball bearings, gather in the crop. Bales measure 16 by 23 in. and can be made in lengths up to 52 in.

Poly-V "J" Drives

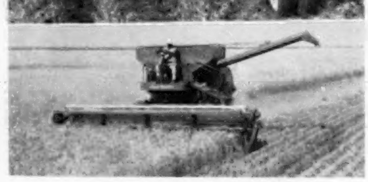
Manhattan Rubber Div., Raybestos-Manhattan, Inc., Passaic, N. J., has announced availability of its new Poly-V "J" drive



through industrial distributors. The new light-duty single belt drive, which can operate on extremely short centers and over sheave diameters as small as 0.8-in. PD, will be made available for applications ranging from ¹⁄₄₀ to 15 hp.

New Combines Announced

Deere & Co., 3300 River Dr., Moline, Ill., has announced production of two new combines. The new pull-type combine is



designed to be able to harvest as many different crops as a self-propelled machine. The other model is reported to be the largest self-propelled combine ever produced.

The new pull-type model 42 can be equipped with a 2-row corn attachment, and is said to have the same harvesting capacity as the smallest self-propelled combine in the company's line, the model 40 self-propelled. It will, however, be equipped with a 9-ft cutting platform compared with an 8 or 10-ft cutting platform on the 40.

The new self-propelled model 105 combine weighs nearly seven tons and is equipped with a 22-ft cutting platform. To match its cutting capacity, the machine has a 50-in. cylinder, 75-bu grain tank, and a 6-cylinder engine which reportedly develops 105 hp. A choice of 16, 18, or 20-ft cutting platform also will be available. A 12-ft platform equipped with an 88 or 110-in. belt pickup will be available for harvesting windrowed crops. A rice model with 14 or 16-ft platform also will be produced. For both the grain and rice models a 4-row corn attachment will be available.

Introduces Lawn and Garden Tractor

International Harvester Co., 180 N. Michigan Ave., Chicago 1, Ill., has announced its entry into the compact lawn and garden

tractor field with the introduction of a new 7-hp Cub Cadet tractor. It is powered by an air-cooled, 4-cycle, 7-hp engine, with electric starter as optional equipment. Power is transmitted from the engine by a completely protected single V-belt to a fully-enclosed, all-gear drive transmission and final drive.

Other specifications include an overall length of 62 in.; overall height of 38 in.; overall width of 33.2 in.; ground clearance of 6 in.; and a wheelbase of 42.7 in.; and a turning radius of 6.7 ft. Total weight of the tractor is 475 lb. A selection of tools and attachments will be available.

6 and 8-Plow Tractors Announced

Oliver Corp., 400 W. Madison St., Chicago 6, Ill., has announced production of two new farm tractor series — The 6-plow-

rated 1800 series, which reportedly set a fuel economy mark of 13.18 hp-hr per gal for gas-powered tractors and a drawbar pull mark of 11,040 lb for diesel row-crop tractors, and the 8-plow-rated 1900 diesel-powered tractors, which, it is said, have set a two-wheel-drive tractor horse-power record of 94.34 maximum corrected PTO hp.

The 1800 series is available both in row-crop and wheatland models and with a choice of 6-cylinder gasoline, diesel, and LP-gas engines. The 1900 tractors are available in wheatland and riceland models with GM 4-cylinder, 2-cycle diesel engine.

New Rod Ends Added to Line

Split Ballbearing, Div. of MPB, Inc., Lebanon, N. H., has announced production of large size rod ends, control rod assem-

blies, and high angle rod ends with studs. The new products contain bearings designed for use where misalignment must be accommodated. The bearings feature a precision ground, through hardened steel race around an oil-impregnated sintered metal ball. The race is manufactured separately. The new products are listed in Catalog 101, available upon request from the manufacturer.

Special Forging Reduces Machining

Union Forging Co., Endicott, N. Y., has produced a special forged retainer (shown) designed to reduce machining. The unit,

weighing 2.7 lb., was forged from 1020 steel. Further details may be obtained upon request from the manufacturer.

Hay Spreader-Conveyor Does "Mowing Away"

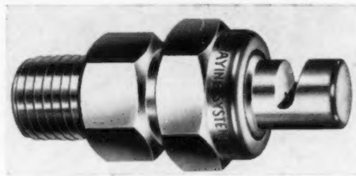
Aerovent Fan & Equipment Co., P.O. Box 9007, Lansing, Mich., has developed an automatic hay spreader and conveyor for use with any elevator and in any barn. In operation, the unit is said to distribute hay evenly and loosely across the mow in a manner favorable to fast and efficient drying.

Mechanically, the unit is lightweight and

may be hung on existing hay tracks. It requires a ½ to 1-hp electric motor, depending on the length of the barn or mow, and it may be reversed to deliver hay in either direction. The spreader attaches to either or both ends of the conveyor. Two sets of tines are synchronized and turn in opposite directions, for spreading hay at right angles to the conveyor. Tines can be adjusted to compensate for various lengths or widths of barns.

New Wide-Spray Nozzle Tips

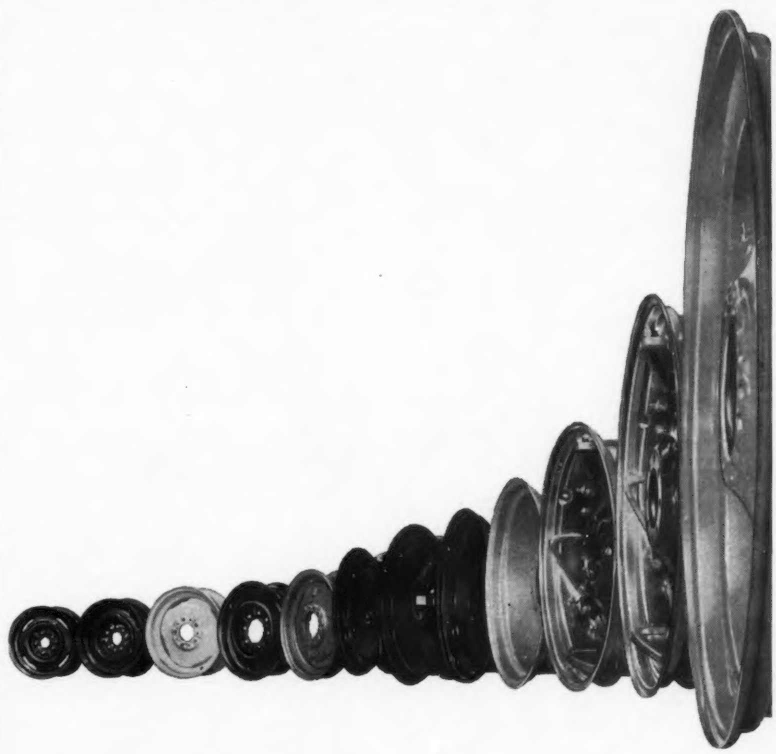
Spraying Systems Co., 3226 Randolph St., Bellwood, Ill., has announced a new series of spray nozzle tips for producing a broad-



cast-type spray with boom mounted spray nozzles. These "TK Floodjet" tips provide a flat, 120-deg angle spray that is projected at an angle of 75 deg to the spray nozzle axis. The wide angle spray permits close-to-ground mounting of the spray nozzle, which, combined with low line pressures that can be used, reduces driftage. The unusually wide spray angle reportedly gives extremely wide ground coverage per nozzle, reducing the number of nozzles needed per boom.

New Bearing Retainer Material

Rollway Bearing Co., Inc., 541 Seymour St., Syracuse 4, N. Y., has developed a new alloyed iron material for roller bearing retainers. The new material reportedly will operate at temperatures up to 800 F; has a coefficient of expansion close to that of steel; will operate satisfactorily under conditions of boundary lubrication; exhibits low permanent expansion or growth at elevated temperatures, and has a yield strength about 1½ times that of bronze.



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PERSONNEL SERVICE BULLETIN

PERSONNEL SERVICE BULLETIN

Note: In this bulletin the following listings current and previously reported are not repeated in detail. For further information, see the issue of AGRICULTURAL ENGINEERING indicated. "Agricultural Engineer" as used in these listings is not intended to imply any specific level of proficiency or registration as a professional engineer. Items published herein are summaries of mimeographed listings carried in the Personnel Service, copies of which will be furnished on request. To be listed in this bulletin, request form for Personnel Service listing.

Positions Open–(1960) **October** – O-318-636, 320-637, 322-638, 322-639, 322-640, 325-642, 326-643, 347-645. **November**–O-372-646, 392-647, 393-648. **December**–O-407-649, 425-651, 429-652. (1961) **January**–O-434-654, 440-655, 461-656, 465-657, 465-658. **February**–O-11-101, 13-102, 10-103, 35-104, 36-105, 57-106. **March**–O-67-107, 76-108, 77-109, 79-110, 71-111, 71-112, 71-113.

Positions Wanted–(1960) **October**–W-305-76, 314-77, 323-78, 328-79. **November**–W-338-80, 377-81, 379-83, 365-84, 376-86, 355-87, 394-88. **December**–W-420-89, 419-90. (1961) **January**–W-431-94, 444-95, 453-96, 468-97. **February**–W-8-1, 21-2, 22-3, 24-4, 29-5, 16-6, 30-7, 34-8. **March**–W-66-9, 32-10, 58-11, 56-12, 75-14, 96-15.

NEW POSITIONS OPEN

Agricultural Engineers (graduate research assistants) for research in vegetable crop harvesting, conveyance of chopped forage, environmental control for tobacco curing, or broiler production, with graduate study leading to MS degree. BSAE or equivalent, with academic average acceptable to graduate school. Interest in research and desire to do graduate work. Graduate study rate 10 semester hours (12 under GI Bill). MS requirement 30 semester hours, including course work and thesis. Research work assignments usually applicable to thesis subject. Applications acceptable throughout year. Stipend $1800 for 10 months or $2160 for 12 months plus remission of tuition ($120 per semester) and non-residents fee ($150 per semester). O-103-114

Field Test Technician to test experimental implements as an aid to design engineers in appraisal. Major full-line manufacturer. Midwest. Age 25-35. BSAE or BSA with major in farm mechanics. Experience 0 to 10 yr. Able to work with design engineers, sales and related personnel. Excellent opportunity for advancement. Salary open. O-129-115

Product Design Engineer for design and development of farm implements from conception through customer use. Major full-line manufacturer. Midwest. Age 25-35. BSAE, BSME, or equivalent. Experience 0 to 5 years. Able to work with manufacturing, sales, service and engineering personnel. Excellent opporunity for advancement. Salary open. O-129-116

Farm Systems Engineer to carry substantial creative responsibility in farmstead systems development on national level. Established manufacturer. Midwest. Age 30-40. BSAE or BSCE. Experience in presenting technical information to groups. Work will require active inquiry into new methods and practices. Involves planning and layout for major market application of a broad and growing line of pre-engineered products and system components. Work with product design engineering in development activities and with sales management in interpreting and serving sales needs. Some travel. Considerable opportunity for advancement in farm engineering division. Additional opportunity according to ability and company needs. Salary $8,000-$10,000. O-95-117

Field Representative for consulting work with rural electric systems; for writing and photography work on uses of electricity; and for policing rural electric finance plan. Midwest. BSAE, and experience with rural electric cooperative desired. Salary $5,500-$6,500. O-155-118

Agricultural Engineer (assistant or associate professor rank) for extension and applied research in mechanization of fruit and vegetable production, including design, development, testing, and demonstration of mechanical units for special crops, with emphasis on harvesting and handling after preliminary survey and evaluation of present methods. Informal cooperation with several academic departments and with growers and industry as appropriate. Also advise graduate students in related projects, and possibly teach advanced agricultural machine design course for graduate students. Eastern state university. Age 25-40. MSAE minimum. PhD preferred. Some experience desirable but not essential. Job requires maturity, imagination, initiative for independent accomplishment, leadership, and ability to work with others. Salary $6,800-$10,000. O-163-119

NEW POSITIONS WANTED

Agricultural Engineer for sales or service in rural electric field with industry or public service in USA, Europe, or South America. Married. Age 32. Weak left eye. BSAE 1953, Auburn University. Farm background. In rural electric work 4½ years with TVA and electric co-op. Self-employed 2 yr. in electrical and plumbing contracting. Military service 2 yr. as medical equipment repairman. Available on reasonable notice. Salary $5,000. W-121-16

Agricultural Engineer for development, research, sales, or management in soil and water or product processing, with industry, preferably in Western USA. Willing to travel. Single. Age 28. No disability. BSAE 1959, University of Missouri. Farm background. Military service completed in Army, 2 yr. as helicopter mechanic. Summer employment in soil conservation. Field and office work with SCS 2 yr. in 1956-57, and in 1960-61. Available on reasonable notice. Salary $6,000. W-112-17

Agricultural Engineer for design, development, or research in power and machinery with manufacturer in Northeast or North Midwest. Single. Age 25. Trick knee, no other disability. BSAE expected in June, University of Maine, Farm background. USAF 4 yr. in drafting, surveying, and inspection. Part time student work in agricultural engineering department. Available in June or July. Salary open. W-135-18

Agricultural Engineer for design, development, research, or writing in farm structures field, with experiment station, consultant, or trade association. Midwest, South or Southwest preferred. Limited travel. Married. Age 29. No disability. BSAE, 1959, Iowa State University. Service experience in USAF 4 yr. prior to college. Experience since graduation in planning complete farmsteads, including design, development and construction of precast concrete buildings. Developed new type of precast concrete building component and method of construction. Available on reasonable notice. Salary open. O-142-19

Agricultural Engineer for design and development in power and machinery with manufacturer. Midwest, East, or South. Prefer small to medium-sized manufacturer of tillage equipment. Married. Self-educated, with considerable home study. Wide range of experience from tooling through all phases of engineering. War service in navy as gunners mate. Available May 15-June 1. Salary $625-$650. W-115-20

Agricultural Engineer for design, development, research, sales, service, writing, or management in farm structures, product processing, or related field, with industry or public service, anywhere in USA, or Canada. Married. Age 39. No disability. MSAE 1952, Iowa State University. College teaching, farm structures subjects 6 yr. Industry experience farm structures field, 5 yr. Available on reasonable notice. Salary $8,000. W-160-21

Agricultural Engineer (student) for work experience in USA in design, development, or research in power and machinery, farm structures, or soil and water field with distributor, consultant, or farming operation. Location in Iowa or elsewhere in Midwest. Single. Age 20. No disability. Preparatory ordinary and advanced level certificates at Northwest Wiltshire Area College, England. Preparing for examination for ordinary national diploma in mechanical engineering in June. Vacation experience on mechanized farms, with processors, and with manufacturers. Available in August. Salary open. W-161-22

Agricultural Engineer for development, research, extension, teaching, sales, service, or management in farm structures, soil and water, or electric power and processing with industry or public service. Southeast preferred. Married. Age 42. No disability. BSAE 1950, Clemson Agricultural College. Experience 3½ yr. as electrification advisor with co-op; 1½ yr. as irrigation sales engineer; 4½ years research with university, on grain drying; nearly one year as representative with trade association. Available on reasonable notice. Salary open. W-162-23

Agricultural Engineer for design, development or research in power and machinery, farm structures, rural electric, or soil and water field, with industry. Any location. Single. Age 28. No disability. BSAE 1959, University of Southwestern Louisiana. Precollege service in Air Force 4 yr. Five months with SCS. Available on two weeks notice. Salary open. W-164-24

Agricultural Engineer for sales and service or sales engineering work in power and machinery, farm structures or farmstead mechanization, with manufacturer or distributor in Midwest. Travel in limited area. Married. Age 42. No disability. BSAE 1940, Ohio State University. War commissioned service in navy, 4 yr. with advancement to Lt. Comdr., USNR. Product education, service and sales work 12 years with wide range of farm machinery and storage equipment. Available on reasonable notice. Salary $750/mo. or equivalent. W-159-25

Agricultural Engineer for development, research, sales, or service in farm structures or rural electrification, with manufacturer, distributor or consultant in Southeast. Occasional travel. Married. Age 22. No disability. BSAE expected May 28, North Carolina State College. Farm background. Work experience on tobacco farms. Available June 1. Salary open. W-166-26

Agricultural Engineer for design, development, sales, service or writing in power and machinery field with manufacturer, federal agency or experiment station. Prefer Southeast. Other locations in USA considered. Married. Age 43. No disability. BSAE 1942, University of Georgia. Farm background. War commissioned service in Army Ordnance. Teaching and research one year. Peanut mechanization research project leader 5 years. With farm equipment manufacturer 10 years as manager of design and development, director of engineering and chief product engineer. Available about May 1. Salary open. W-171-27

Agricultural Engineer for executive level design job. Any location. Experience comprises design, development, testing, and final preparation of designs of many kinds of farm machinery. Highly creative with several patents assigned to previous employers. Farm background. Over twenty years of executive and administrative level design experience. Available on short notice. Salary open. W-178-28

The following is a list of recent applicants for membership in the American Society of Agricultural Engineers. Members of the Society are urged to send information relative to applicants for consideration of the Council prior to election.

Anderson, James R.–Irrigation engr., Larchmont Engineering. (Mail) 336 Lowell St., Wilmington, Mass.

Beert, Camiel J. – Product tester, test eng. dept., International Harvester Co. (Mail) 533 20th Ave., Rock Island, Ill.

Byrne, William W. – Dist. mgr., Chain Belt Co., 4125 Whitaker Ave., Philadelphia 24, Pa.

Carr, Richard L. – Serv. mgr., John Deere Co. (Mail) 1780 W. First Ave., Columbus, Ohio

Clifford, Herbert B. – Proj. and des. engr., Harvesters Implements, Inc. (Mail) 4492 E. Madison, Fresno 2, Calif.

Cunningham, Wayne E. – Product tester, International Harvester Co. (Mail) 2057 Hemlock Ave., Davenport, Iowa

DeRoos, Donald J. – Proj. engr., Hawkeye Steel Products, Inc., P.O. Box 149, Waterloo, Iowa

Dickey, Gylan L. – Student, Fresno State College. (Mail) 844 S. Ninth St., Fresno 2, Calif.

Downing, Michael L. – Eng. co-ordinator, East Moline Wks., International Harvester Co., 1100 Third St., East Moline, Ill.

Farmer, John – Engr. in charge of drawing office, Honolulu Iron Wks. (Mail) 3019 Hibiscus Dr., Honolulu, Hawaii.

Foster, Gibbs C. – Sales rep., farm dept., Niagara Mohawk Power Corp., 300 Erie Blvd., W., Syracuse 2, N. Y.

French, Herbert C. – Co-pilot, Northwest Airlines. (Mail) 5828 Nicollet Ave., Minneapolis 19, Minn.

Gill, William R. – Soil scientist, National Tillage Machinery Laboratory, Box 792, Auburn, Ala.

Gochanour, Carroll Q. – Product tester, International Harvester Co. (Mail) 1640 20th Ave., Moline, Ill.

Jennings, Mearl J. – Jr. engr., John Deere Harvester Wks. (Mail) 5317 11th Ave. A, Moline, Ill.

Johnson, Clifton W. – Hydraulic engr., (ARS) USDA. (Mail) 3631 Berry Dr., Boise, Idaho

Johnson, William D. – Pres., Red Devil Butane Gas Co., Inc., 700 N. Main St., Franklin, Ky.

Komuchar, Victor J. – Chief engr., Farm Equip. Res. Eng. Center, International Harvester Co., 7 S. 600 County Line Rd., Hinsdale, Ill.

Lent, Ralph C. – Dir., ind. eng. dept., Ewa Plantation Co., P.O. Box 1327, Ewa, Hawaii *(Continued on page 212)*

Close-up of Deere unit shows Condor Flat Whipcord Belt on a separator drive and two Manhattan Agricultural Traction Drive V-Belts transmitting power from engine to wheels through a variable speed sheave.

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MANHATTAN RUBBER DIVISION, PASSAIC, NEW JERSEY

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. . . Membership Applicants

(Continued from page 210)

Lewis, Ransford, Jr. — Exec. vice-pres. and gen. mgr., The H. C. Shaw Co., P.O. Box 2168, Stockton, Calif.

Maticic, Brane I. — Asst. prof. of agr. eng., Faculty of Agr., University of Ljubljana. (Mail) Preradoviceva str. 46, Ljubljana, Yugoslavia

Maurer, Eugene M. — Area mgr., Mel Miller & Co. Inc. (Mail) 410 N. Folger, Carrollton, Mo.

McCarty, Horace G.—Sr. product engr., New Holland, Machine Co., Div. of Sperry Rand Corp., New Holland, Pa.

McMunn, John C. — Assoc. engr., structural dynamics group, McDonnell Aircraft Corp. (Mail) 9425 Edmund Rd., St. Louis 14. Mo.

Meppen, Arthur D. — Civil engr., Minnesota Dept. of Conservation. (Mail) R.R. 1, Racine, Minn.

Moynihan, Patrick A. — Product designer, Massey-Ferguson, Inc. (Mail) 7296 Auburn, Detroit 28, Mich.

Ochs, Walter J. — Construction engr., (SCS) USDA. (Mail) P.O. Box 505, Britton, S.D.

Olsen, Edwin C., III — Graduate student, Utah State University. (Mail) 451 W. Second, S., Logan Utah

Oltrogge, Ralph E. — Comptroller, Association of Illinois Electrical Co-ops., 416 S. Seventh St., Springfield, Ill.

Phukan, Samudradev — Lecturer, Assam Eng. College. (Mail) 605 S. Meldrum, Fort Collins, Colo.

Rothe, Robert W. — Area engr., (SCS) USDA. (Mail) 2703 Belmeade, Brownwood, Texas

Russo, Rubens — Agr. engr., Servico Do Vale Do Paraiba-Largo Santa Luzia S/N, Taubate-Estado, De Sao Paulo, Brazil

Smith, Don E. — Reg. supervisor, portable products dept., American Air Filter Co., Inc., 215 Central Ave., Louisville 8, Ky.

Smith, Melvin R. — Engr. and personnel mgr., Association for International Development. (Mail) 389 Main St., Paterson, N. J.

Tahry, Hussein El — Chief, budget and program section and community dev. section, Egyptian American Service for Rural Improvement. (Mail) c/o Room 7617, Bureau of Reclamation, Interior Bldg., Washington 25, D. C.

Walters, Robert E. — Highway engr., U.S. Forest Service. (Mail) P.O. Box 548, Gold Beach, Ore.

Westervelt, William W. — Analytical engr., Hamilton Standard Div., United Aircraft Corp. (Mail) Wynding Hills Rd., East Granby, Conn.

TRANSFER OF MEMBERSHIP

Booker, Walter W. — Head, test div., John Deere Ottumwa Wks. (Mail) 305 S. Milner, Ottumwa, Iowa (Associate Member to Member)

Brown, Eugene C., Jr. — Product engr. and head, tillage machinery div., J. I. Case Co. (Mail) 1218 Drexel Blvd., Rockford, Ill. (Associate Member to Member)

Coles, Errol D. — Tech. officer, irrigation dept., hydrological branch, Room 8132, Causeway, Southern Rhodesia (Associate Member to Member)

Dorgan, Robert J. — Engr., John Deere Tractor Res. and Eng. Center, Waterloo, Iowa (Associate Member to Member)

Henderson, Harry D. — Prof. of agr., Wisconsin State College and Institute of Technology. (Mail) 213 Pitt St., Platteville, Wis. (Affiliate to Member)

McCurdy, Joseph A. — Ext. agr. engr., Pennsylvania State University, 108 Agr. Eng. Bldg., University Park, Pa. (Associate Member to Member)

Wendling, Leo T. — Ext. agr. engr., eng. ext. dept., Kansas State University, Umberger Hall, Manhattan, Kans. (Associate Member to Member)

STUDENT MEMBER TRANSFERS

Adkins, John W. — (A. and M. College of Texas) 600 E. State St., Eagle Lake, Tex.

Anderson, Paul W. — (University of Illinois) State Highway Dept., Elgin, Ill.

Ash, David M. — (University of Illinois) Caterpillar Tractor Co., Decatur, Ill.

Beek, Harlan E. — (Iowa State University) With U.S. Army. (Mail) R.R. 2, George, Iowa

Boppart, Loren P. — (University of Illinois) Starline Inc. (Mail) R.R. 3, Woodstock, Ill.

Burger, Thomas B. — (Purdue University) 509 W. 9th St., Jasper, Ind.

Butler, James L. — (Louisiana Polytechnic Institute) 3019 Meadows, Shreveport, La.

Carter, Harold L. — (A. & M. College of Texas) R.R. 1, Roby, Tex.

Cheney, Kenneth M. — (University of Nebraska) With U. S. Army. (Mail) Pilger, Nebr.

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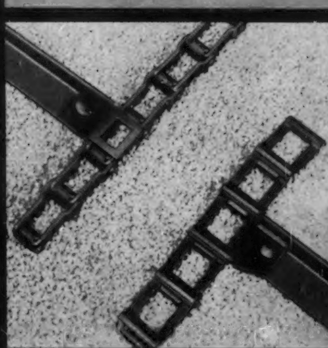
LOCKE Steel Pintle Chain and Locke Steel Detachable Sprocket Chain provide low-cost and dependable power transmission in the finest farm machinery.



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Cookson, Kenneth M. — (Purdue University) R.R. 1, Arthur, Ill.

Craig, George F., Jr. — (University of Tennessee) Knoxville Trailer Court, Knoxville 19, Tenn.

Delanty, Patrick R. — (Iowa State University) South Blue Lake Rd., Onawa, Iowa

Delfs, Larry M. — (Iowa State University) John Deere Harvester Wks., East Moline, Ill.

Fangmeier, Delmar D. — (University of Nebraska) 4330 W St., Lincoln 14, Nebr.

Fisher, Fred E. — (South Dakota State College) Box 2, Oelrichs, S. D.

Gentry, Richard W. — (Texas Technological College) SCS, USDA, Lewelland, Tex.

Golka, Robert J. — (University of Nebraska) Nebraska State Highway Dept. (Mail) 1633 Que St., Lincoln, Nebr.

Graham, Douglas L. — (Purdue University) 409 Harrison, West Lafayette, Ind.

Grantham, Johnny D. — (Louisiana Polytechnic Institute) 1306 Davis Blvd., Ruston, La.

Henry, Kenneth R. — (Texas Technological College) Pelco, Peoria, Ill.

Hickey, Edward W. — (Texas Technological College) International Harvester Co., 714 E. 10th St., Amarillo, Tex.

Hobson, John L. — (Iowa State University) John Deere Tractor Wks., Dubuque, Iowa

Horn, Claud R. — (University of Tennessee) 2011 Lily Ave., S. W., Knoxville, Tenn.

Hutchison, James B., Jr. — (A. & M. College of Texas) R.R. 4, Clarksville, Tex.

Jasper, Herman F. — (Kansas State University) John Deere Plow Co., 3210 E. 85th St., Kansas City, Mo.

Kelley, Lawrence G. — (Purdue University) R.R. 1, North Salem, Ind.

Kipple, Frank P. — (Kansas State University) Long Island, Kans.

Kirchhofer, James E. — (Purdue University) R.R. 2, Berne, Ind.

List, David W. — (Ohio State University) 428 N. Pickaway St., Circleville, Ohio

Mapes, Merlin E. — (Iowa State University) R.R. 2, Earlham, Iowa

McBride, John M. — (Ohio State University) 25 W. Frambes Ave., Columbus 1, Ohio

McWilliams, Bobby L. — (Mississippi State University) R.R. 2, Carriere, Miss.

Nethery, John M. — (Purdue University) Bur. of Reclamation, Provo, Utah

Ninke, Raymond A. — (South Dakota State College) Webster, S. D.

Pickett, Leroy K. — (Kansas State University) agr. eng. dept., Univ. of Illinois, Urbana, Ill.

Renken, Wilbur L. — (University of Illinois) International Harvester Co., Farm Practices and Res. Eng. Center, Hinsdale, Ill.

Shuyler, Lynn R. — (Kansas State University) 1727 Simms, Topeka, Kans.

Storjohann, Donald R. — (Iowa State University) Waverly, Iowa

Teske, Orville C. — (University of Illinois) R. R. 2, Cissna Park, Ill.

Threlkeld, Vernon L. — (Purdue University) 2808 W. Alhambra Rd., Alhambra, Calif.

Troeger, John M. — (Ohio State University) R.R. 5, Box 210, Ashland, Ohio

Waund, William W. — (Iowa State University) Primghar, Iowa

Werkmeister, William H. — (University of Nebraska) Deere & Co., Moline, Ill.

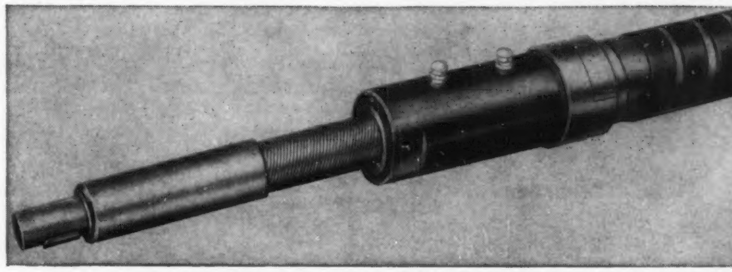
Wilkins, Dale E. — (Purdue University) R.R. 1, Platteville, Wis.

Winitz, Marvin — (Kansas State University) 80 Henry St., New York, N. Y.

Wunsch, Bobby E. — (Kansas State University) Field Queen Inc., Maize, Kans.

Wyatt, David R. — (University of Idaho) With U.S. Navy. (Mail) 2313 Ninth Ave., Lewiston, Ida.

HOW TO SELECT FLEXIBLE SHAFTING FOR POWER DRIVE APPLICATIONS



1¼-inch STOW Power Drive flexible shaft with core assembly pulled out of casing.

For Power Drive applications, the following factors must be considered:

1. Torque (Lb. In.) to be transmitted. (The starting torque should be used in making selections).

2. Operating Speeds (RPM)—If the maximum speed is higher than the rated speed, torque ratings in the table below do not apply. To find the torque capacity for flexible shafts operating at speeds higher than the rated speeds, multiply the maximum dynamic torque capacity by the rated speed, and then divide by the operating speed. (See example).

3. Operating Radius—In making the selection from the table below, the radius of the smallest bend in the flexible shaft should be used.

Ratings — The ratings for flexible shafts shown in the table below apply under the following conditions:

1. When the flexible shaft is adequately supported by clamps along its length. (For unsupported shafts, multiply the calculated torque by a safety factor of 1.6—see example below)

2. When the flexible shaft is operated in the wind-up direction, which tends to tighten the outer layer of wires. (Flexible shafts operated in the unwind direction will transmit only about 60% of the rated torque).

3. When the flexible shaft is in continuous operation. Note: **the ratings are based on temperature rise. When the operation is intermittent, the ratings in the table may be exceeded. Consult Stow Engineers for specific recommendations.**

RATED SPEED R.P.M.	MAXIMUM DYNAMIC TORQUE CAPACITY (LB. IN.) STRAIGHT AND CURVED SHAFTS RADIUS OF CURVATURE IN INCHES									Wgt./ C. Ft.	Core Dia.	Core No. and Type	Shaft Size
	50 to Strgt.	25	20	15	12	10	8	6	5				
4,500	2.4	2.2	2.0	2.0	1.92	1.9	1.7	1.5	1.25	3.0	.124/.128	2049 MH	13
3,800	7 0	6.4	6.0	5.8	5.4	5.0	4.6	3.6	2.0	4.5	.148/.152	2081 MH	15
2,900	9.4	8.6	8.0	7.6	7.0	6.6	6.0	4.8	3.4	7.0	.185/.189	5108 MH	19
2,500	22.0	20.0	18.8	17.6	16.0	15.0	12.6	10.8	9.0	12.5	.247/.252	8924 MH	25
1,800	30.0	28.0	26.4	25.0	23.0	21.0	18.0	14.0		20.0	.308/.313	8925 MH	31
1,800	33.8	31.5	29.7	28.1	25.9	23.6	20.2	15.8		20.0	.308/.313	8969 T	31
1,800	36.0	33.0	31.6	30.0	28.0	26.0	22.0	18.0	11.0	21.0	.324/.329	2034 A	31
1,500	80.0	66.0	63.0	58.0	51.0	46.0	37.0	22.0		28.5	.368/.374	2035 A	38
1,500	60.0	54.0	50.0	46.0	42.0	38.0	30.0	24.0		29.0	.387/.393	8970 MH	40
1,500	90.0	81.0	75.0	69.0	63.0	57.0	45.0	36.0		29.0	.387/.393	8971 T	40
1,150	136.0	110.0	104.0	94.0	80.0	72.0	56.0			50.5	.497/.503	8999 A	50
1,150	148	124	110	92	72	56				53.5	.505/.511	6940 T	50
900	248	200	176	124	84					78.5	.610/.618	6997 T	63
900	220	204	192	180	152	130				80.5	.630/.638	7731 A	63
750	340	224	156	76						117	.747/.753	2056 T	75
600	760	520	420							205	.998/1.004	2057 T	100
440	1,500	720								343	1.298/1.304	2058 T	125

EXAMPLE — How to use the table:

The problem is to transmit ½ H.P. at 1700 RPM through an unsupported flexible shaft in a 25" radius, estimated starting torque 150% of normal operating torque.

1. Calc. Torque (lb. in.)—

$$\frac{\text{HP} \times 63000}{\text{RPM}} = \frac{.5 \times 63000}{1700} = 18.5$$

2. Correction factor for starting torque 1.5 x 18.5=27.75

3. Correction factor for unsupported shaft 27.75 x 1.6 = 44.4 lb. in.

4. Refer to Table above. Read downward in column under 25" radius until you find a core having a rating of at least 44.4 lb. in. In this case we find that core No. 8970 is rated 54 lb. in. at 1500 RPM. Since the given speed is 1700 RPM, multiply 54 by 1500 and divide by 1700. 54 × 1500 ÷ 1700 = 47.6 lb. in. (rated torque at 1700 RPM). Therefore, Core No. 8970 is correct.

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. . . New Books

(Continued from page 205)

In this book the author shows how predictions can be made of vehicle performance and design parameters and discusses soil and snow mechanics, tracks, wheels, and tires, as well as general factors having to do with vehicles at assumed optimum performance. He also describes the important developments taking place in industry and education, offering a strong claim that automotive research can remain vital only if it is broadened to include theoretical as well as design analysis.

An Introduction to the Scientific Study of the Soil, Fourth Edition, by the late Norman M. Comber and revised by W. N. Townsend. Cloth. 5 x 7½ in. xii+232 pages. Illustrated and indexed. Published by St. Martin's Press Inc., 175 Fifth Ave., New York 10, N. Y. $4.75.

In this book consideration of the various soil constitutents to illustrate their individual properties is undertaken first, followed by a study of the effects of the integration and interrelationships of these constituents in the whole soil and culminating in the practical utilization of it by man.

From Theory to Practice in Soil Mechanics. Selections from the writings of Karl Terzaghi, with bibliography and contributions on his life and achievements prepared by L. Bjerrum, A. Casagrande, R. B. Peck, and A. W. Skempton. Cloth. 8½ x 11¼ in. viii+425 pages. Illustrated. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. $12.00.

Karl Terzaghi, civil engineer, in the last century has exerted much influence on his profession, establishing and developing a new branch of engineering science. In this volume an account is given of his life and his method of working. The representative selection of papers (which are in English, for the most part) includes those that established the science of soil mechanics, a selection of his professional reports that indicate his methods of dealing with specific jobs, and a complete bibliography of his works.

Food for America's Future, by Ethyl Corp. Cloth. 5⅜ x 8 in. xii+192 pages. Published by McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 36, N. Y. $3.95.

An examination of this nation's potential ability to feed its growing population in the foreseeable future — by 1975 — is presented in this book. It gives the views of twelve acknowledged authorities in research, soil science, education, farm machinery, electric power, chemicals, food processing, marketing, and economics. It tells what has been done, is being done, and will be done to better equip the farms and industries of America to meet the needs of an expanding population.

Mechanization Agriculture, edited by J. L. Meij. Cloth. 6¼ x 9 in. xi + 379 pages. Illustrated and indexed. Published by Quadrangle Books, Inc., Chicago 1, Ill.

In this book an international team of specialists provide a systematic view of the circumstances and impact of the technological change on the farm. Included are a historical introduction and essays on the course of mechanization in the United States and Europe, followed by chapters on the problems of farm management, labor, financing, marketing, and on the small farm as a special case. The book concludes with a comparison of agricultural and industrial mechanization and their consequences.

. . . News

(Continued from page 197)

Movie awards will be made in two classes, those prepared by industrial or commercial organizations and those developed by colleges, universities, and other public agency groups. Any group or any individual who has developed a movie during the past year is eligible to enter this competition by writing to V. M. Meyer, extension agricultural engineer, Iowa State University, Ames, Iowa.

Radio and television exhibits: Kinescope recordings, movie shorts made for television use or charts, photos, slides, or other specimen used in the preparation of television programs which might make an interesting exhibit for ASAE can be entered in this competition. Radio tapes, radio scripts or outlines, or information on radio programs made by agricultural engineers can be entered in the competition for the blue ribbon award. Radio and television material will be judged separately. Application forms are available from D. P. Brown, extension agricultural engineer, Michigan State University, East Lansing, Mich.

Slides are one of the most effective teaching aids in extension programs. A set of slides showing agricultural engineering developments or a method of teaching some phase of agricultural engineering may be submitted. Slides from industrial groups and public agency groups will be judged separately. For entry forms, write to R. O. Gilden, extension agricultural engineer, Federal Extension Service, USDA, Washington 25, D.C.

Extension Methods and Recipes: This phase of exhibits gives the extension agricultural engineer an opportunity to swap ideas on how best to carry out certain jobs connected with his work. Write F. N. Reece, extension agricultural engineer, Kansas State University, Manhattan, Kans., for application forms.

Closing dates for entries in all classes will be about June 10.

Marks 75th Anniversary

The Progressive Farmer magazine marked 75 years of publication with its February issue. Special editorial features, geared to expanding reader service and information for the future, with a brief glance at the past, highlight the issue. Predictions of scientific farming methods 25 years from now — livestock, farm chemical and farm building technological advancements — share the editorial spotlight with such illustrated articles as: "Destination — Moon and Beyond," for young folks; "Southern Education Wears Seven League Boots;" "Less Sickness, Longer Life;" and a wide range of articles on cooking, sewing and homemaking for the southern rural housewife.

Two articles written by ASAE members deal with trends in agricultural engineering and farming in the future. "Farm Machines of the Future," written by ASAE member Ed Wilborn (editor of Mississippi-Arkansas-Louisiana edition), is the title of one of these articles, which points out that automation in agriculture is not coming — it is here in many cases. The second article, "The Trend Is Toward More Factorylike Farm Buildings," is written by G. W. Giles, former head of agricultural engineering at North Carolina State College, now serving as program specialist in farm equipment for the Ford Foundation Mission to India.

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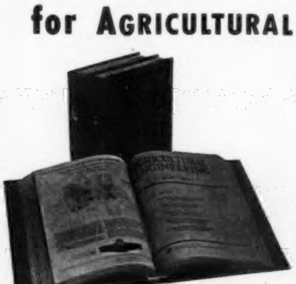

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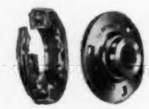

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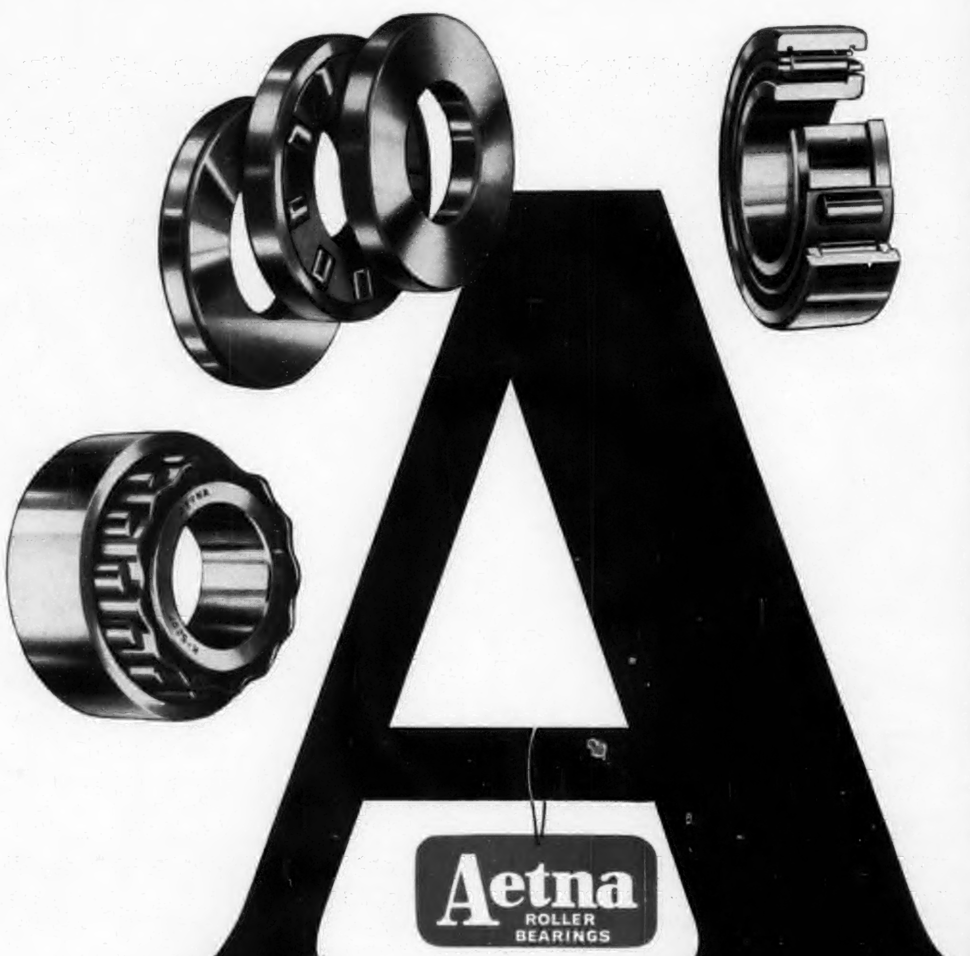

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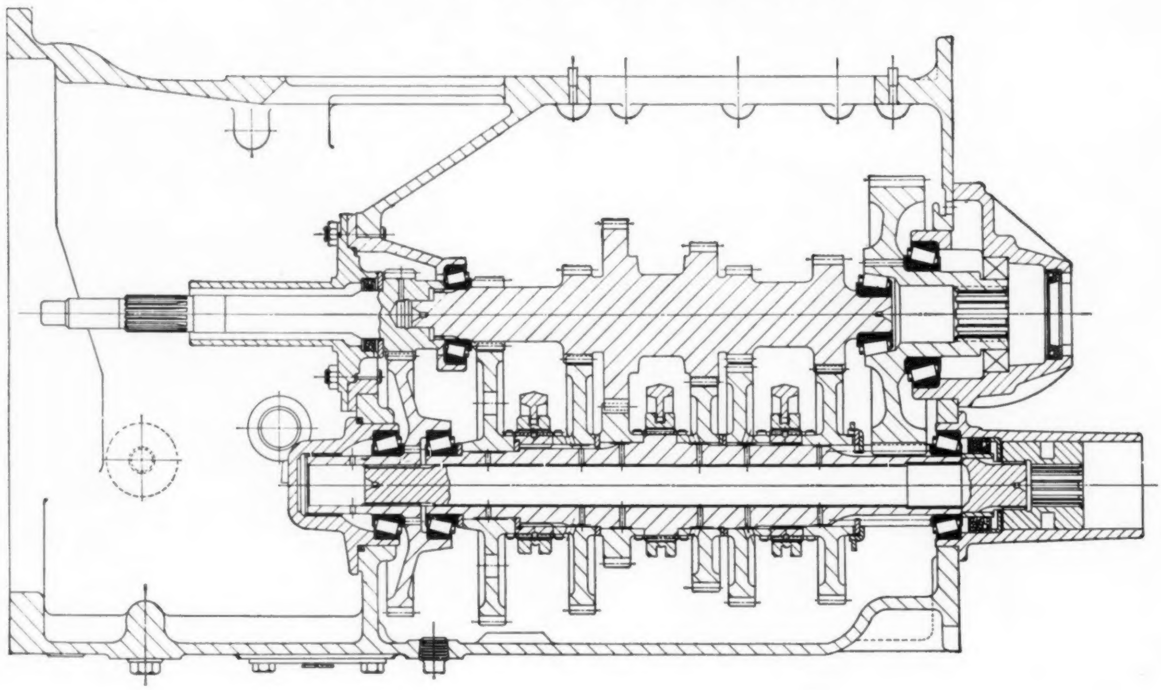

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